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THE NATIONAL GEOGRAPHIC MAGAZINE

OCTOBER, 1923

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TO carry out the purposes for which it was founded thirty-five years ago, the National Geographic Society publishes this Magazine. All receipts are invested in the Magazine itself or expended directly to promote geographic knowledge.

ARTICLES and photographs are desired. For material which the Magazine can use, generous remuneration is made. Contributions should be accompanied by an addressed return envelope and postage.

IMMEDIATELY after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resultant given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization which was waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the historic expedition of Admiral Peary, who discovered the North Pole.

NOT long ago The Society granted $25,000, and in addition $75,000 was given by individual members through The Society to the Federal Government when the congressional appropriation for the purchase was insufficient, and the finest of the giant sequoia trees of California were thereby saved for the American people and incorporated into a National Park.

THE Society is conducting extensive explorations and excavations in northwestern New Mexico, which was one of the most densely populated areas in North America before Columbus came, a region where prehistoric peoples lived in vast communal dwellings whose ruins are ranked second to none of ancient times in point of architecture, and whose customs, ceremonies and name have been engulfed in an oblivion more complete than any other people who left traces comparable to theirs.

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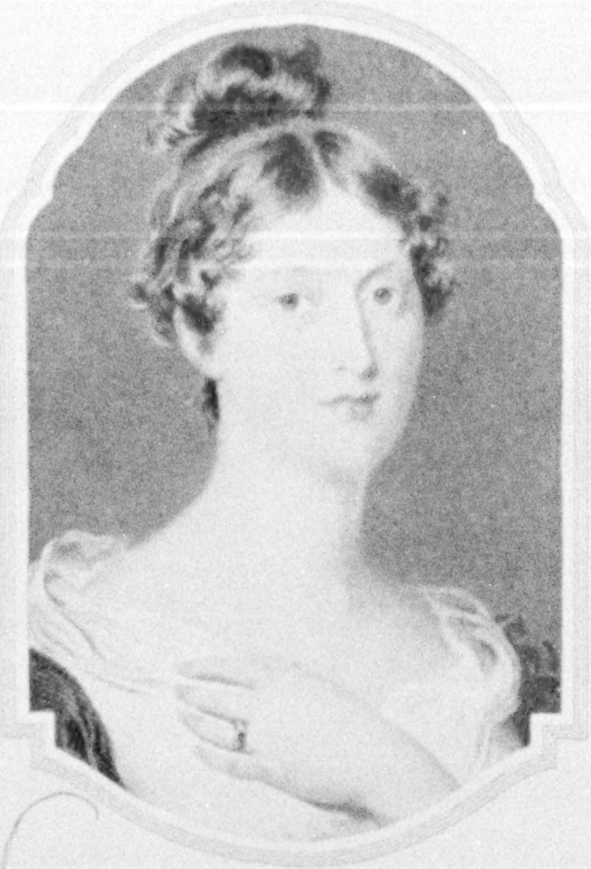
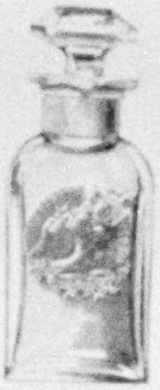


Parfumeur to Princess Charlotte *1817*

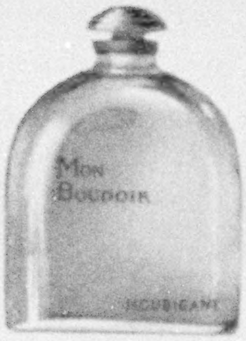
HOUBIGANT ODEURS

Quelques Fleurs
Le Parfum Idéal
Un Peu d'Ambre
Le Temps des Lilas
Violette Houbigant
Coeur de Jeannette
Quelques Violettes
Mon Boudoir
La Rose France
Premier Mai
Parfum Inconnu
D'Argeville
Jasmin Floral
Mes Delices

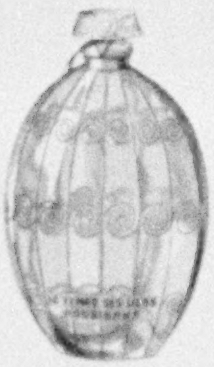


Le Parfum Idéal—subtly alluring and distinctive.

THROUGHOUT the centuries the sovereignty of France in certain arts has remained unquestioned by the world. In perfume making, France has had no rival since the establishment of the House of Houbigant, in 1775. It was an exquisite talent—that of the founder of this great French House. To Marie Antoinette, he paid tribute with enchanting perfumes created for her use; and soon was famous. To-day, women of distinguished place in every Court of Europe testify to the magic skill of another HOUBIGANT by their unvarying preference for HOUBIGANT extraits. All these inimitable perfumes, together with fine colognes, powders and other delightful toiletries, are now available in America. You will find them at smart shops everywhere.



Mon Boudoir—the essence of French sophistication.



Le Temps des Lilas—Spring embodied in a perfume.

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A vitally important place in every home

Often the health of your family depends upon the purity of the products in your medicine cabinet

THERE is nothing you buy in which purity and reliability are of greater importance than in the requisites for your medicine cabinet. Such products are often used in emergencies, or in accordance with the advice of your physician. They must be pure and of correct strength, or they may be ineffective, even harmful.

For generations, E. R. Squibb & Sons have assumed the responsibility for the purity and reliability of the medicine cabinet requisites in many thousands of homes. These requisites include practically every familiar household product. Each combines true purity with some essential point of superiority that you will recognize and appreciate.

For instance, Squibb's Sodium Bicarbonate, because of its extreme purity, is free from the usual objectionable taste. Squibb's Castor Oil is not the offensive, unpleasant cathartic that is taken under protest by so many people, especially children. By careful refining and purifying, it is made almost entirely free from the offensive taste *without affecting its medicinal value.*

When you buy products for your medicine cabinet, the name "Squibb" assures you a full guaranty of purity and reliability. It guarantees you products which are as pleasant to take, and as convenient to use, as the highest scientific knowledge and professional integrity can make them.

THE "PRICELESS INGREDIENT" OF EVERY PRODUCT IS THE HONOR AND INTEGRITY OF ITS MAKER

Castor Oil Squibb
E. R. Squibb & Sons, New York

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Squibb's Sodium Phosphate
Squibb's Castor Oil
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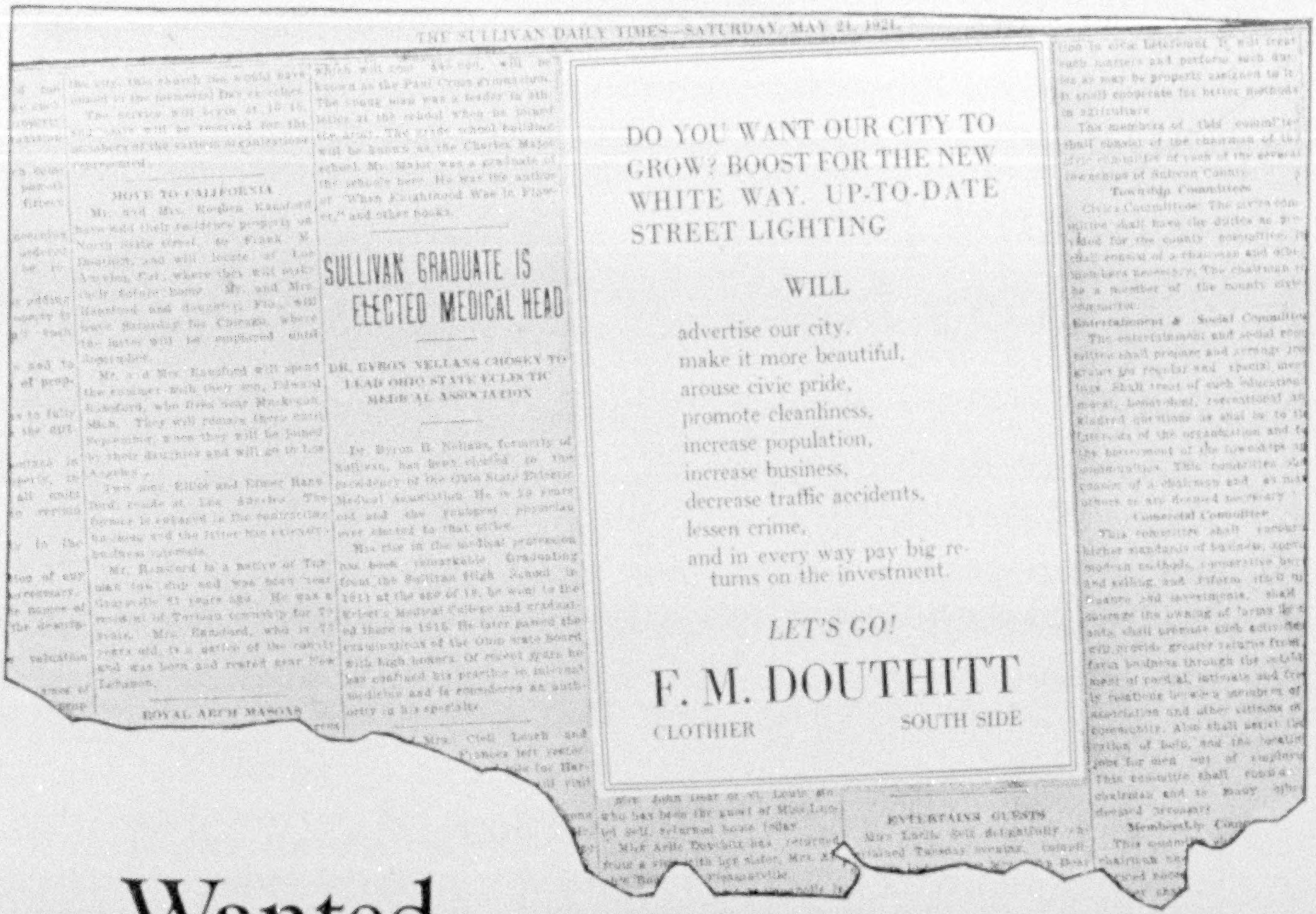


THE SULLIVAN DAILY TIMES—SATURDAY, MAY 21, 1921.

SULLIVAN GRADUATE IS ELECTED MEDICAL HEAD

DO YOU WANT OUR CITY TO GROW? BOOST FOR THE NEW WHITE WAY. UP-TO-DATE STREET LIGHTING

WILL

advertise our city,
make it more beautiful,
arouse civic pride,
promote cleanliness,
increase population,
increase business,
decrease traffic accidents,
lessen crime,
and in every way pay big returns on the investment.

LET'S GO!

F. M. DOUTHITT

CLOTHIER SOUTH SIDE

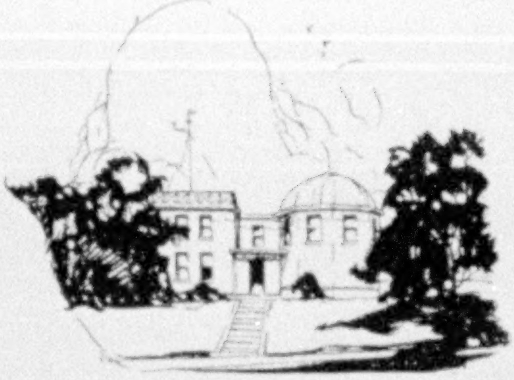
Wanted—
10,000 Mr. Douthitts

The same street lighting specialists who advised the citizens of Sullivan are at your service. They are part of the General Electric Company's organization of 100,000 men and women, co-operating with your electric light and power company to make electricity do more and better work.

The 4,489 residents of Sullivan, Indiana, now have 263 street lights instead of 68. Many citizens helped, among them F. M. Douthitt, who spent his own money in advertising to create public sentiment.

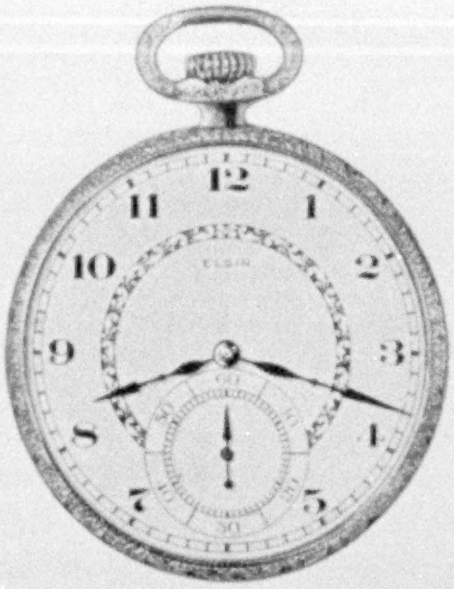
No merchant could possibly do his town a better service. America needs 10,000 Mr. Douthitts in 10,000 towns.

GENERAL ELECTRIC



The Elgin Time Observatory

Elgin time is broadcasted three times daily, at 12 noon, 6 p.m. and 12 midnight Central Standard Time, from the Elgin Time Observatory through Station WDAP—the Drake Hotel, Chicago—The Elgin Time Observatory is the only one operated by a watch company in practical time taking service every day.



The "Streamline" Elgin in 20-year Gold-filled Case, Plain or Engraved, $35.

Elgin takes the time from the stars and puts it in your pocket

OUT in Elgin, Illinois, there is a spick and span little building standing all by itself on a little knoll.

This is the Elgin Time Observatory—for the sole purpose of recording the exact time from the passage of the stars across the meridian.

The astronomer makes 110 star records in each night's observations—and the time is correct within a few thousandths of a second.

Now to put this precise time into your pocket.

This is the function of four master clocks.

These clocks are checked and corrected day after day by the star observations. They transmit the exact time second by second to the Elgin Laboratories and Timing Rooms.

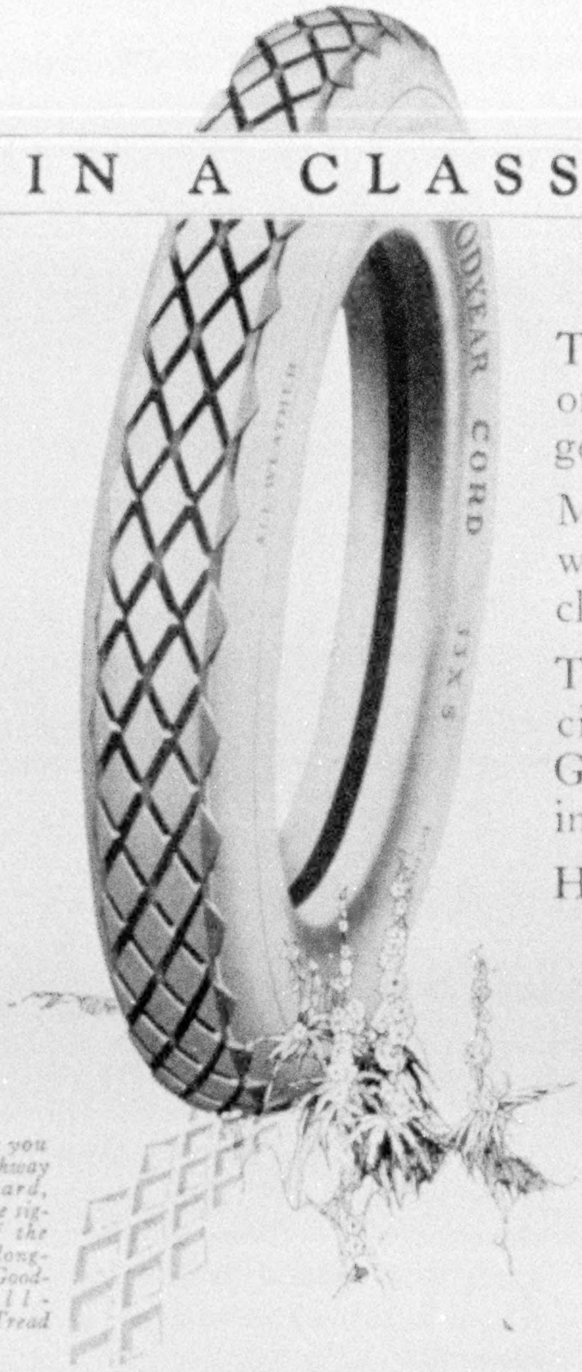
The Elgin Watch you put into your pocket or clasp on your wrist was checked hour after hour, day after day, through all the critical process of adjusting and timing, against the star time observed by the astronomers in the spick and span little building standing all by itself on the little knoll.

ELGIN

The Professional Timekeeper

ELGIN NATIONAL WATCH COMPANY, ELGIN, U. S. A.

IN A CLASS BY ITSELF



Wherever you are, on highway or boulevard, look for the signature of the clinging, long-wearing Goodyear All-Weather Tread

To many motorists, all tires fall into one of two classes: they are either good or bad.

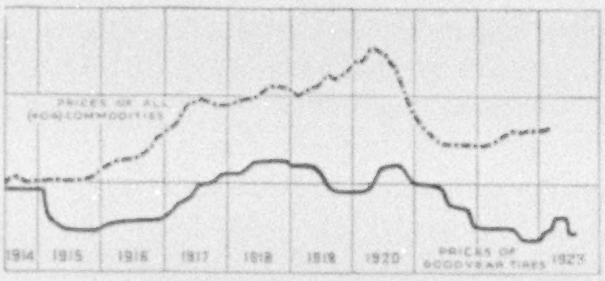
More observing car owners, however, who check tire performance more closely, make yet a further distinction.

These motorists, recognizing the special and unique excellence of the Goodyear Cord Tire, view it as being in a class by itself.

Here are the reasons:

> They know by experience that under normal conditions the Goodyear Cord Tire will deliver them *extra* thousands of miles.
>
> They know that this mileage is superior in *character* as well as in extent, in every point of traction, dependability and freedom from trouble.
>
> They know that Goodyear Cord Tires are sold under a pledge of service, designed to help the user get *all* the mileage built into the tires at the factory.
>
> They know that the *new* Goodyear Cord, with its heavier sidewalls, stronger ply-unions, beveled and longer-wearing All-Weather Tread and other features, is the greatest of all Goodyears, and beyond question the most economical tire they can buy.

Goodyear Means Good Wear



A Good Time to Buy Goodyears

Over the past ten years Goodyear Tires have been steadily improved. Despite this, prices on Goodyear Tires have consistently been kept below the average price level for all commodities, as the above chart shows. Although Goodyear Tires today are better than ever before, Goodyear prices are 37% below those of 1920, and 30% below those even of 1914. This is a good time to buy Goodyears.

GOODYEAR

Copyright 1923, by The Goodyear Tire & Rubber Co., Inc.

PACKARD

Single-Six

It has to be a pretty good Yankee car that can overcome my initial prejudice; but when after doing that it contrives to fill me with an uncontrollable lust for possession, then I can assure you it is something right out of the common rut.

The Single-Six Packard costs (*in England*) something under nine hundred pounds, and is, in my humble opinion, as near being the very best car in the world as makes no difference. This is heavy praise, I know, but it can't be helped—I must speak as I find.

If I had leisure and one of these cars, I would like to drive it round Coventry and Birmingham and Manchester, and other places where motors are mostly made, and take British managing directors out for a run, just to show them, you understand.

The plain fact is that this is a car in which I simply cannot find a fault.

It is as docile as an angel, but goes like the very devil. It is supremely well sprung, it is uncannily silent, it is a miser on petrol, it steers no heavier than a wisp of cigarette smoke, it climbs like a chamois—in short, it just does anything that it should, and does most things a good deal better than you would think possible.

Mind you it is not one of these undergeared contraptions, for without any fuss or flurry it will do its modest seventy on the level, nor has it got a huge engine, yet it will do White Hill, Henley, with four up, at a minimum of twenty-five miles an hour. The Hindhead brings it down to about fifty-five! The Single-Six is, of course, not to be confused with the Twin-Six.

Yes, believe me, people, the six-cylinder Packard is a very wonderful car indeed. I wish it were made in this country, and I can't for the life of me see why it shouldn't be, though owing to the higher cost of raw material over here it would naturally come out more expensive.

I heartily wish the Packard were British.

It is easily amongst the first half-dozen best cars in the world, at a figure which has hitherto been associated with, comparatively speaking, mediocrity.

—Reprinted from The Tatler, London, England; issue of April 11, 1923

ASK THE MAN WHO OWNS ONE

XUM

The Longines Watch

THE superior accuracy of the Longines movement is a matter of common knowledge. The record it has established in open competition is on file at world famous observatories.

Longines cases are our own exclusive creations, each being especially designed and individually executed by us. They are obtainable only with Longines movements.

Such an unusual combination has made the Longines watch a favorite the world over and is one of the reasons why leading jewelers sell and recommend it.

A. WITTNAUER COMPANY
Established 1866
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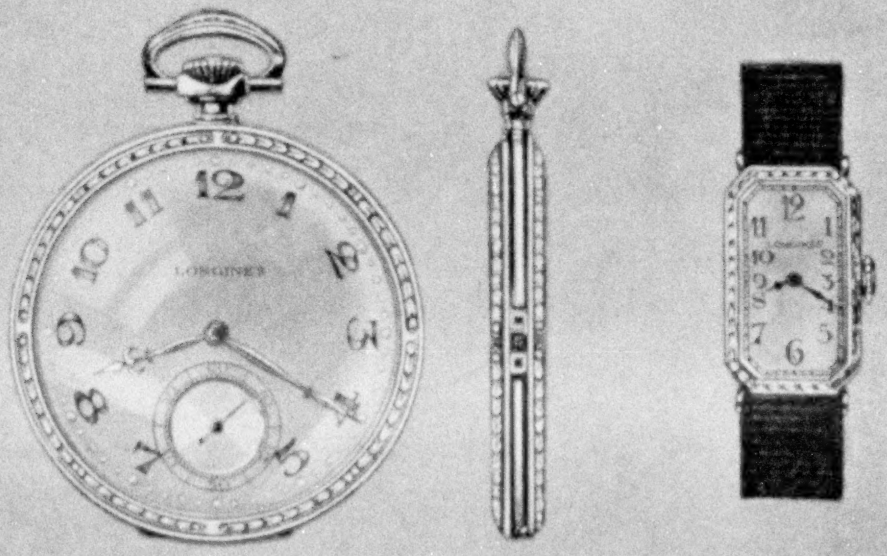
Standard of A. WITTNAUER CO. NEW YORK WATCHES *the World*



Case, hand carved and black and white enameled. Case, hand carved.

DODGE BROTHERS

TOURING CAR

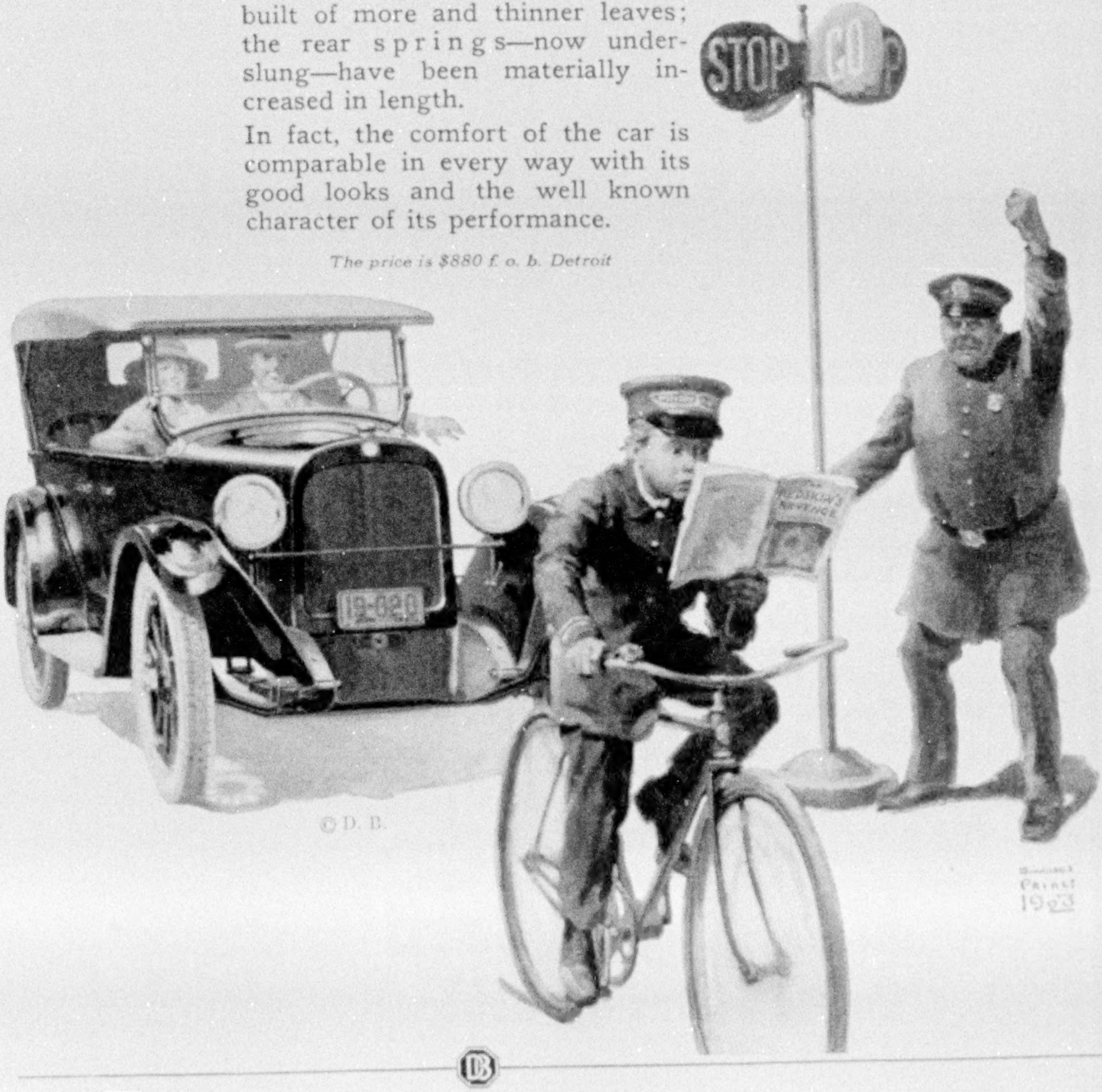
In city traffic or on the open road, this new touring car impresses you instantly with its exceptional riding comfort.

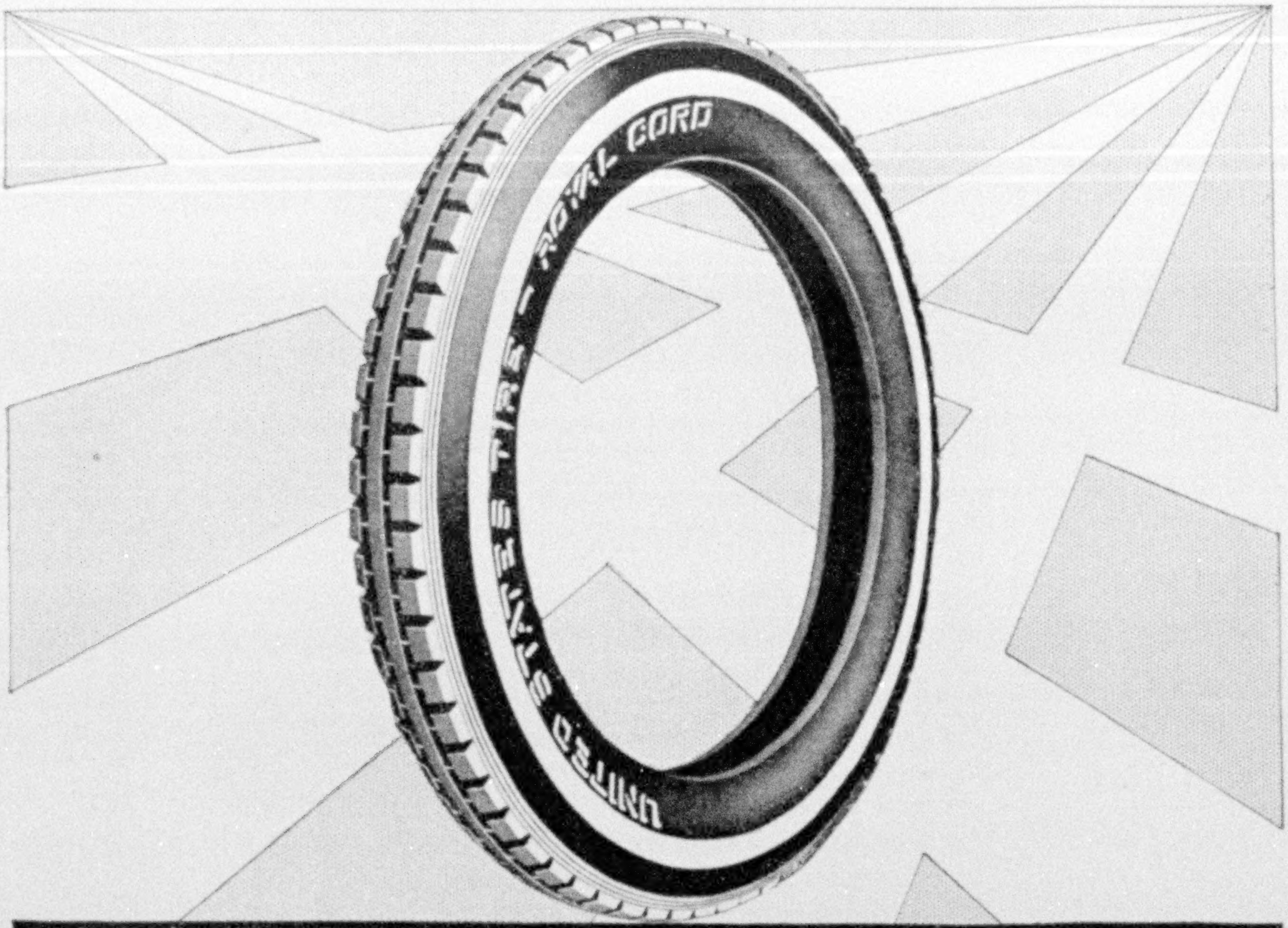
The seats are deeper and lower. The body has been lengthened to afford more leg-room. Its low-swung design reduces side sway and increases the car's stability at all speeds.

The front springs are wider, and built of more and thinner leaves; the rear springs—now underslung—have been materially increased in length.

In fact, the comfort of the car is comparable in every way with its good looks and the well known character of its performance.

The price is $880 f. o. b. Detroit




UNITED STATES TIRE — ROYAL CORD

Why the Royal Cord man is the busiest tire dealer in town

ROYAL CORDS came out this year with three new advantages.

These are the three new U. S. Rubber discoveries:

Flat Band Process—ensuring the positive length, angle and strength of each cord.

Web Cord—the first successful method of impregnating cords with pure rubber by direct soaking in the latex.

Sprayed Rubber—the first absolutely pure rubber.

These discoveries have been put to the test by thousands of car owners.

They are showing a practical money's worth that no one can question—and everybody is talking about it.

So there are many new customers coming in to the Royal Cord dealer—and his old friendships are stronger than ever.

United States Tires
are Good Tires

U. S. Royal Cord Tires

United States Rubber Company

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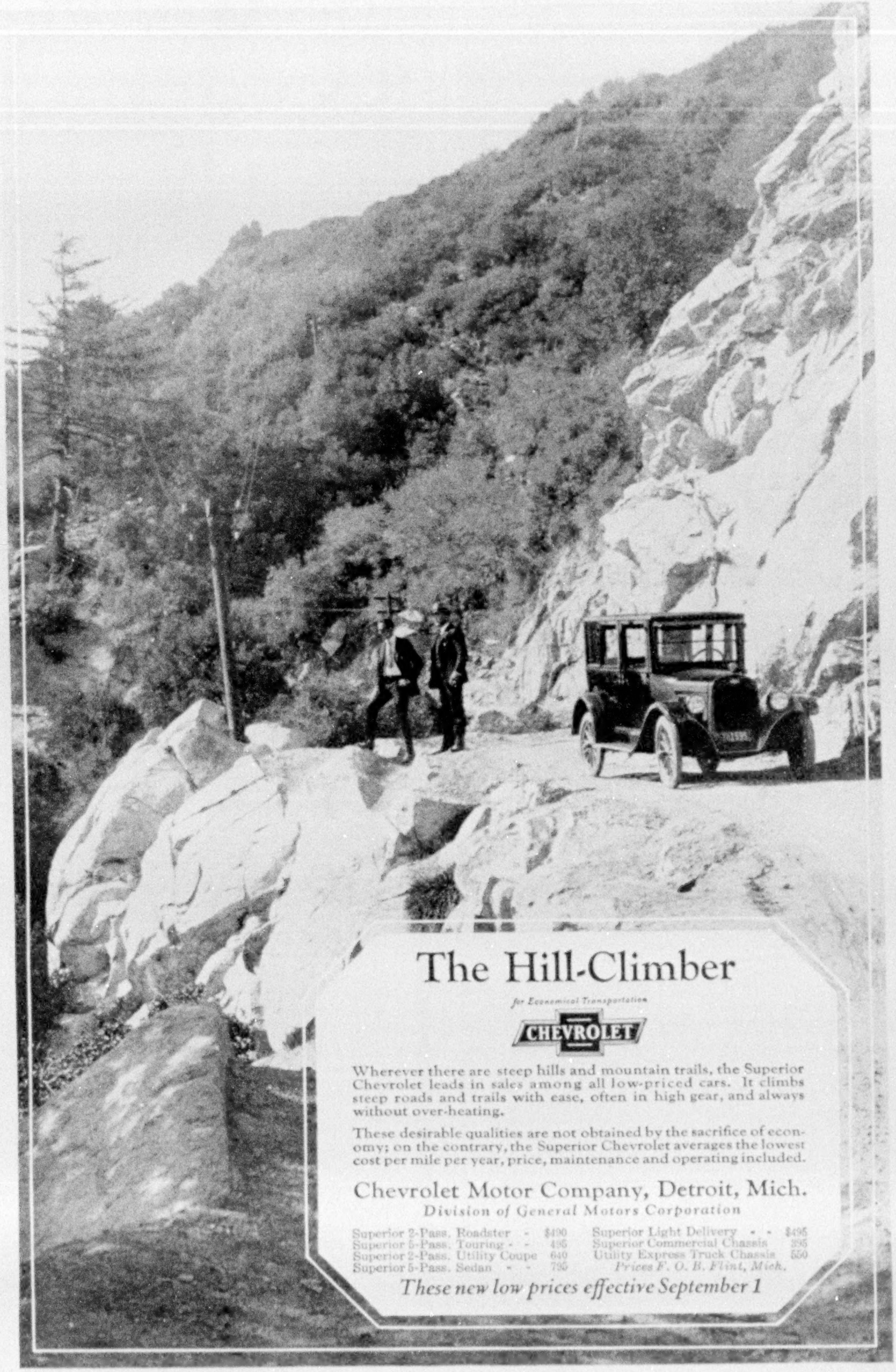

The Hill-Climber

for Economical Transportation

CHEVROLET

Wherever there are steep hills and mountain trails, the Superior Chevrolet leads in sales among all low-priced cars. It climbs steep roads and trails with ease, often in high gear, and always without over-heating.

These desirable qualities are not obtained by the sacrifice of economy; on the contrary, the Superior Chevrolet averages the lowest cost per mile per year, price, maintenance and operating included.

Chevrolet Motor Company, Detroit, Mich.

Division of General Motors Corporation

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Superior 5-Pass. Touring - -	495	Superior Commercial Chassis	395
Superior 2-Pass. Utility Coupe	640	Utility Express Truck Chassis	550
Superior 5-Pass. Sedan - -	795	*Prices F. O. B. Flint, Mich.*	

These new low prices effective September 1

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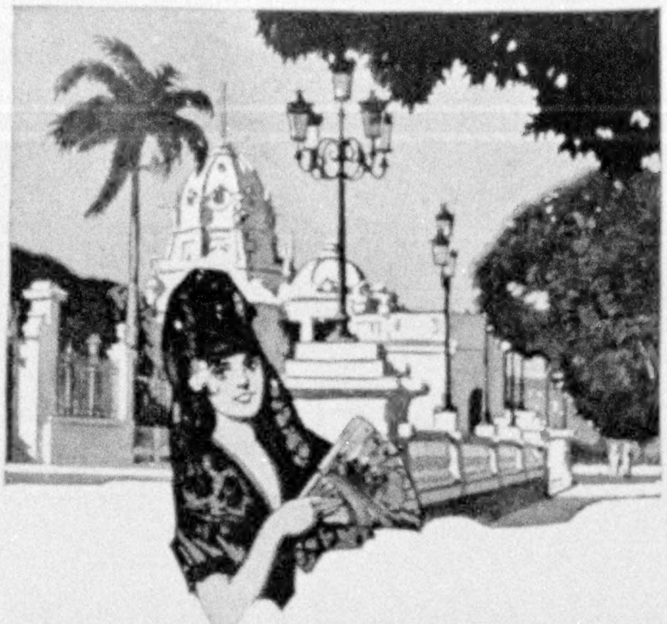

To SOUTH AMERICA

An ideal sea trip-

IF you would enjoy a thoroughly delightful Southern sea voyage, let your government help you plan a trip to South America this autumn. Visit sparkling Rio de Janeiro—now less than 12 days away in the midst of ideal late spring climate. Enjoy gay cosmopolitan activity in Buenos Aires and Montevideo. Live in the most modern of luxurious hotels in a setting of almost tropic splendor.

Four new sister ships that comprise the fleet are the fastest on the route. The cost of the trip is surprisingly low. Send the information blank below. You incur no obligation.

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Western World . . .	**Nov. 24**	**Jan. 19**

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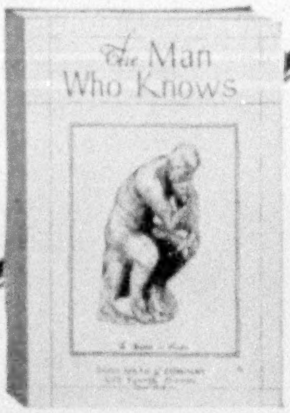
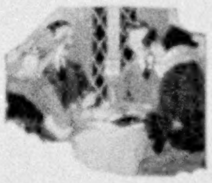
"The Man Who Knows"



May we send you this inspiring booklet with our compliments? The coupon brings your copy

You will enjoy this interesting little book with its brief but significant stories of three of history's most striking characters. And then there is "A Little Story about You" from which you may get a suggestion of real importance in your career. An illuminating, profusely illustrated booklet is this—yours without cost or obligation.

What Is It Worth to You to Know?



When you face situations that call for facts—in the office, in the club, at a social gathering—what is it worth to you in influence and leadership, *in dollars and cents*, to meet these demands without hesitation? Success in life depends so largely upon your reserve of knowledge that you must have readily available such an infallible source of Knowledge as

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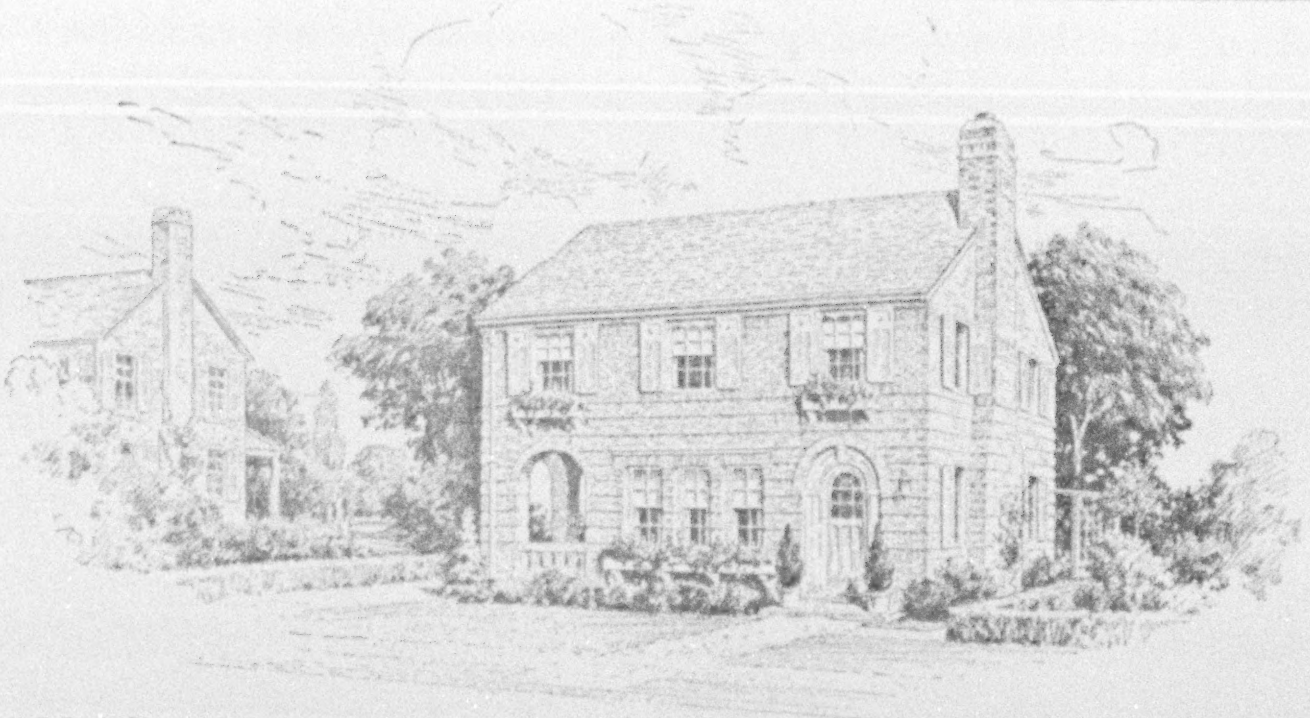


A. F. B. A. House No. 115 — *Designed by Christian F. Rosberg*

This is one of the fifty attractive and distinctive houses shown in "The Home of Beauty"

Homes of Beauty and Durability

TIME enhances the charm of the Face Brick house as age enriches the beauty of its color tones. The passing years exact little toll, for the Face Brick house is truly the permanent, economical house. It lasts for generations; its repair and upkeep charges are negligible; it requires painting only around doors and windows; it saves insurance costs; and lowers fuel bills. Every home-builder will be interested in the facts about the Face Brick house, as told in "The Story of Brick." For your copy, address American Face Brick Association, 1737 Peoples Life Building, Chicago, Illinois.

A·F·B·A
USE FACE BRICK
—it Pays

Send for these booklets:

"The Story of Brick" is an attractive booklet with beautiful illustrations of modern homes, and discusses such matters as Comparative Costs, Basic Requirements in Building, the Extravagance of Cheapness, Financing the Building of a Home, and kindred subjects. A copy will be sent free to any prospective home-builder.

"Face Brick Bungalow and Small House Plans" embrace 96 designs of Face Brick bungalows and small houses. These houses are unusual and distinctive in design, economical to build, and convenient in floor plan. "Face Brick Bungalow and Small House Plans" are issued in four booklets, showing 3 to 4-room houses, 5-room houses, 6-room houses, and 7 to 8-room houses. The entire set for one dollar; any one of the books, twenty-five cents. We can supply complete working drawings, specifications and masonry quantity estimates at nominal prices.

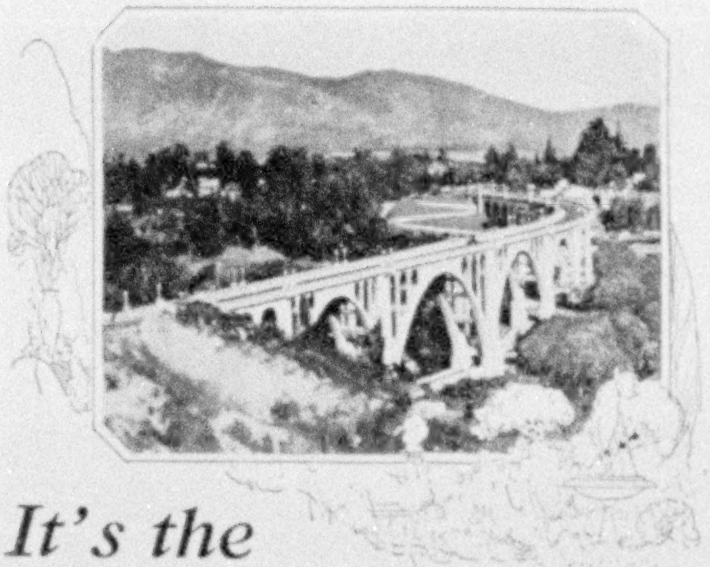
"The Home of Beauty" contains fifty designs of Face Brick houses, mostly two stories, representing a wide variety of architectural styles and interior arrangements. These houses were selected from 350 designs submitted in a nation-wide Architectural Competition. Sent for fifty cents. We also distribute complete working drawings, specifications and quantity estimates for these houses at nominal cost.

"The Home Fires" is a new book containing twenty attractive original fireplace designs, for which complete plans may be purchased for one dollar, and twenty-five pictures of fireplaces designed by well-known architects. Also an article on fireplace construction. Sent for twenty-five cents.

— where it's Maytime the year 'round

Pasadena

"Home City Beautiful"



It's the

Gem of California

by the mountains, near the sea

THE setting is among the orange groves, beside mountains a mile high.

The sparkling Pacific and great beaches, a few miles to the south.

Within the city and near by are *ten* famous courses where golf is at its best every day in the year.

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A place to see, to visit, and in which to "live" a life of real contentment amid year 'round sunshine and flowers. An incomparable climate.

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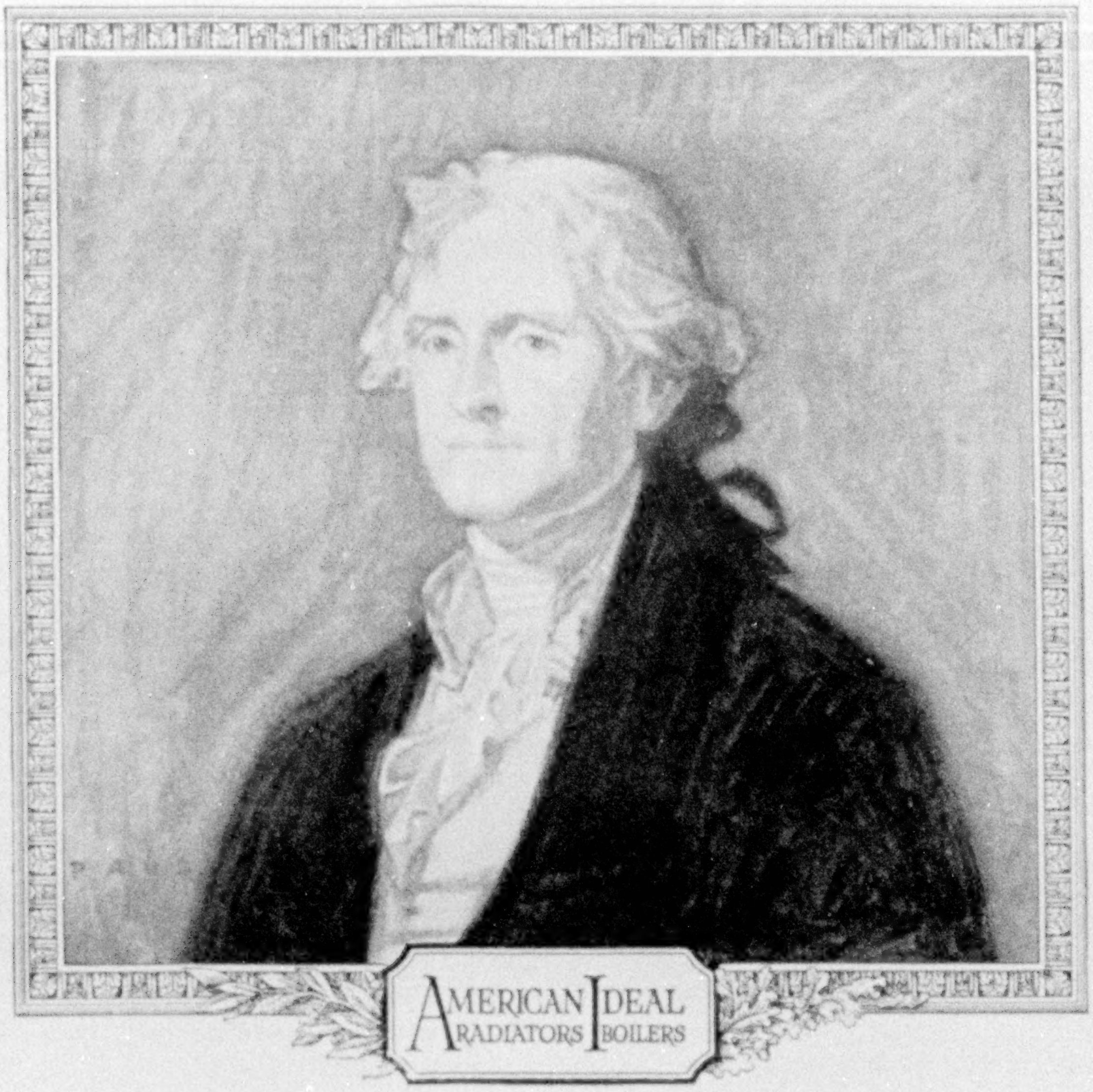

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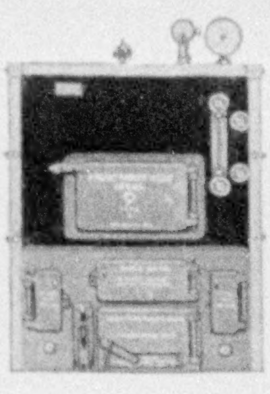

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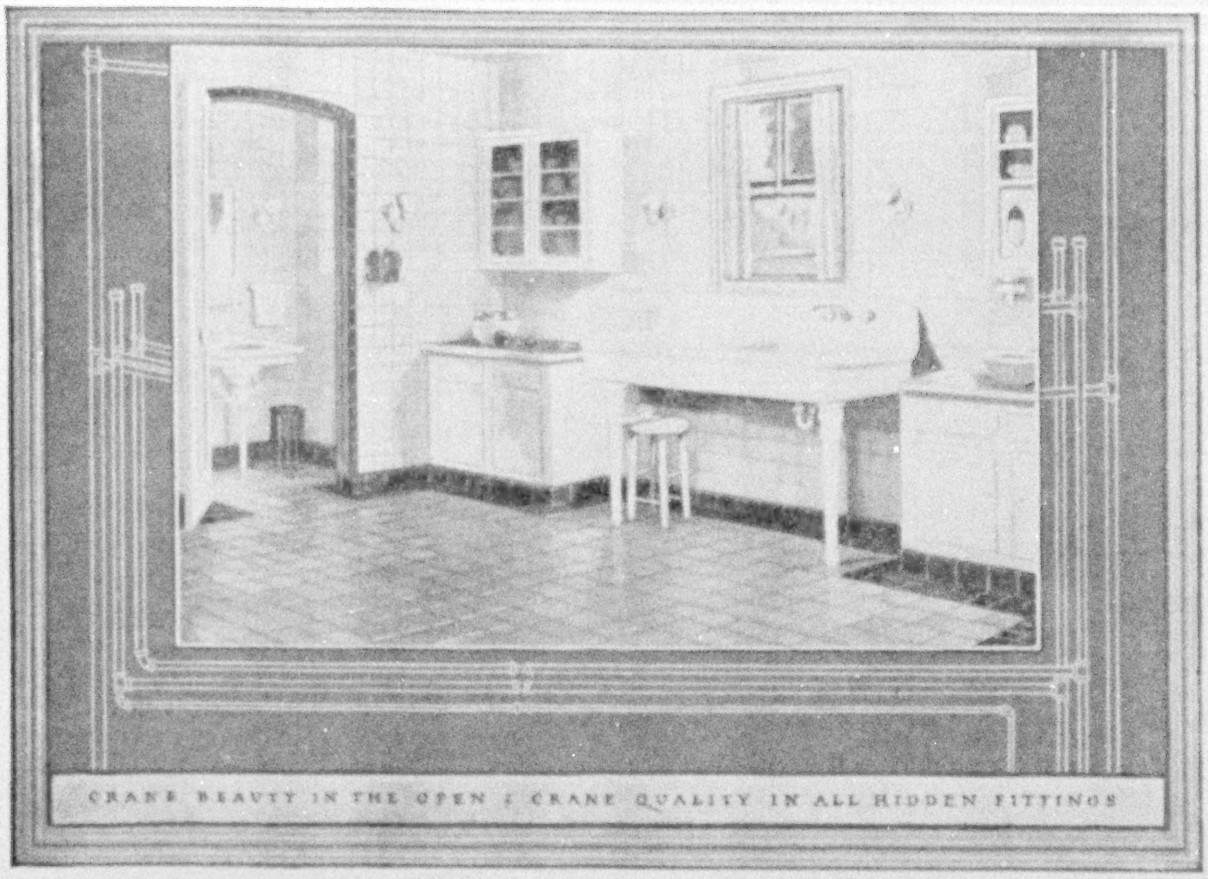

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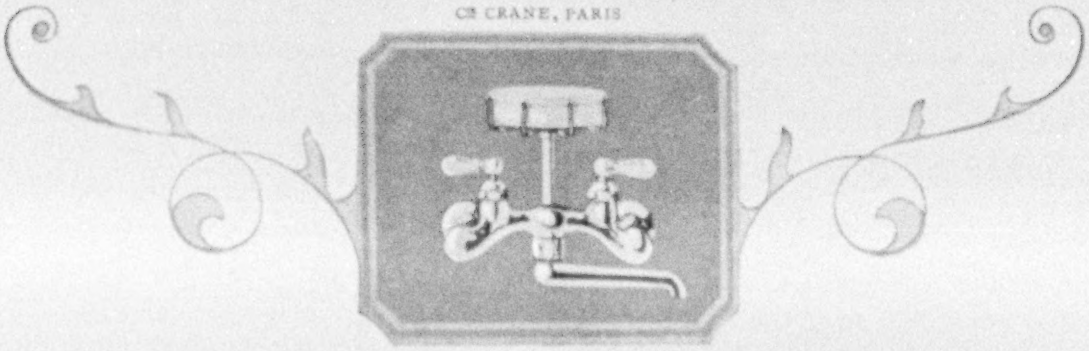

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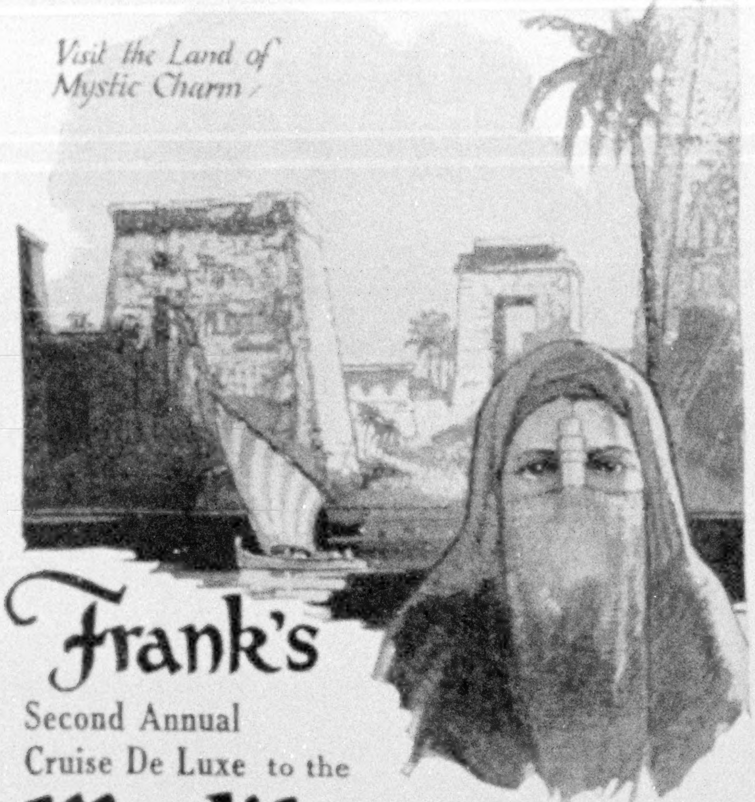
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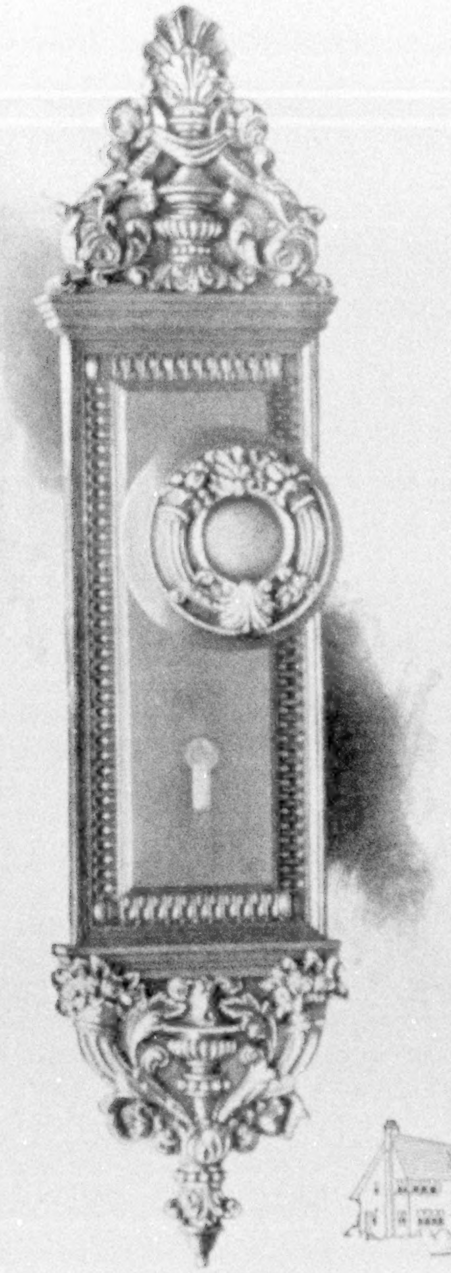

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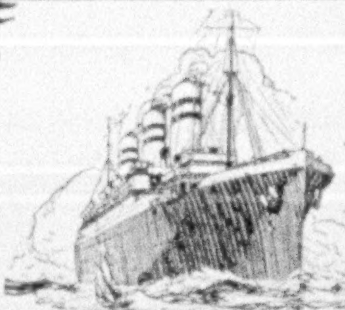

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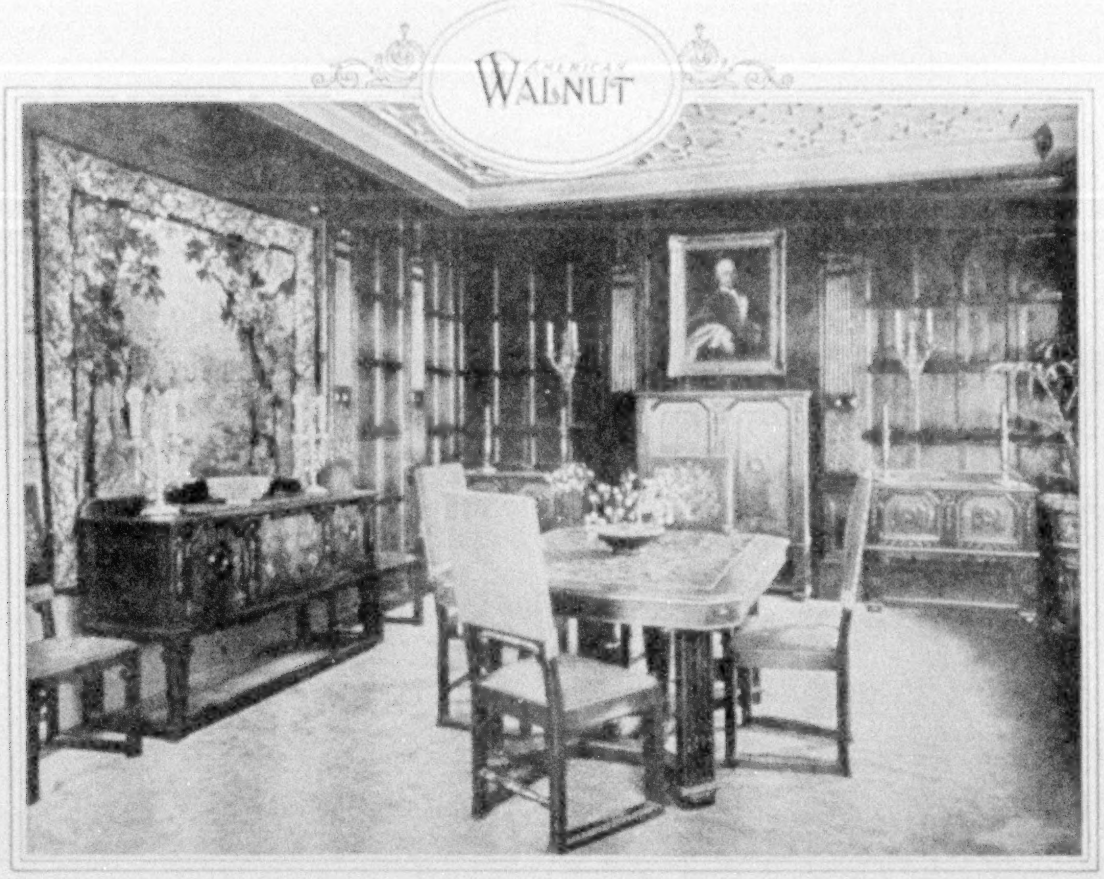

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AMERICAN WALNUT

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1—Ask if it is real walnut—if all exposed surfaces are real walnut.

2—Walnut has characteristic pores which appear on the surface as fine pen lines, dots or dashes, easily visible. Substitute woods do not show these lines, dots or dashes *distinctly*.

3—Make sure that legs, rails, and mouldings are of the same wood as tops, fronts, and sides—real walnut.

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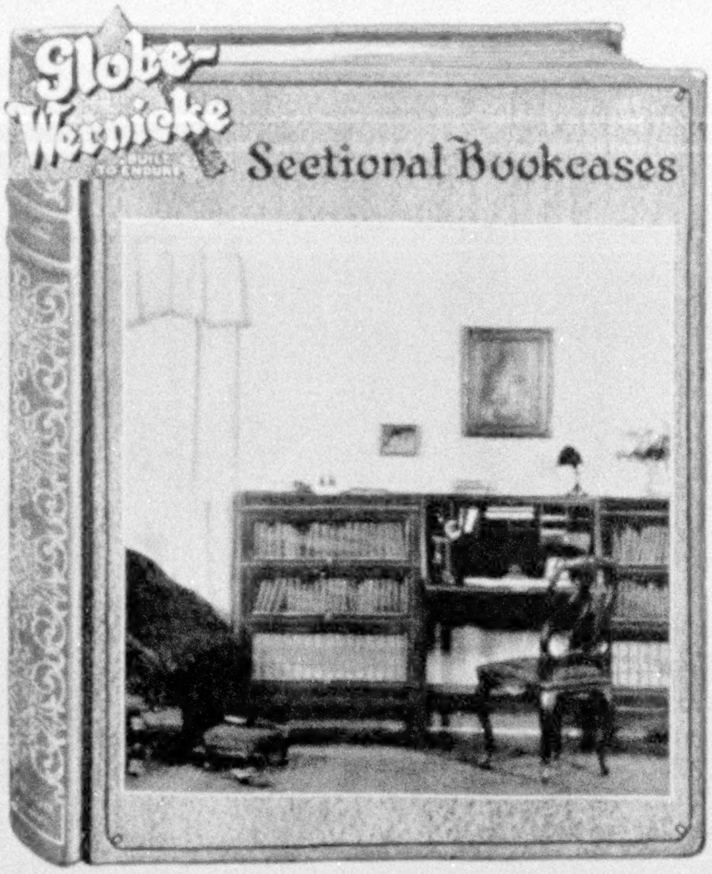

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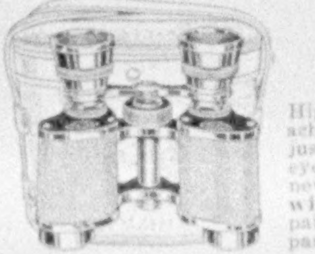

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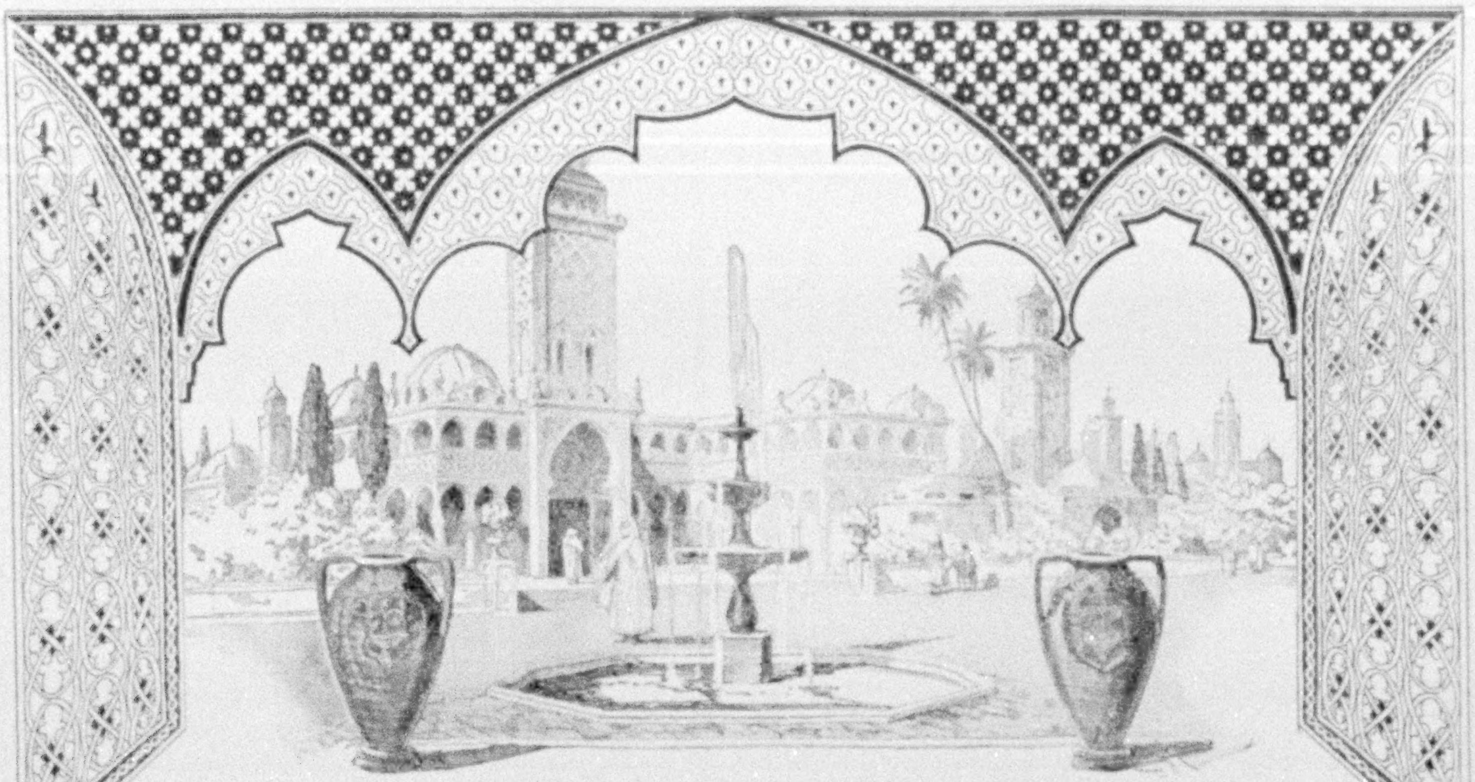

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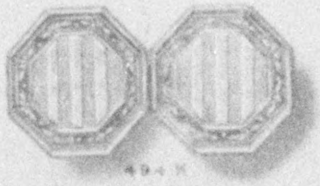
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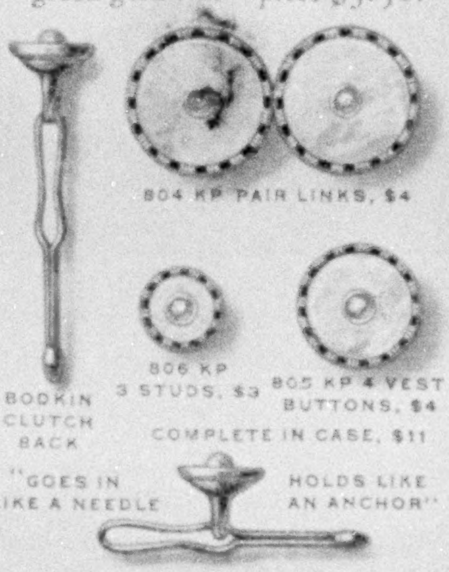
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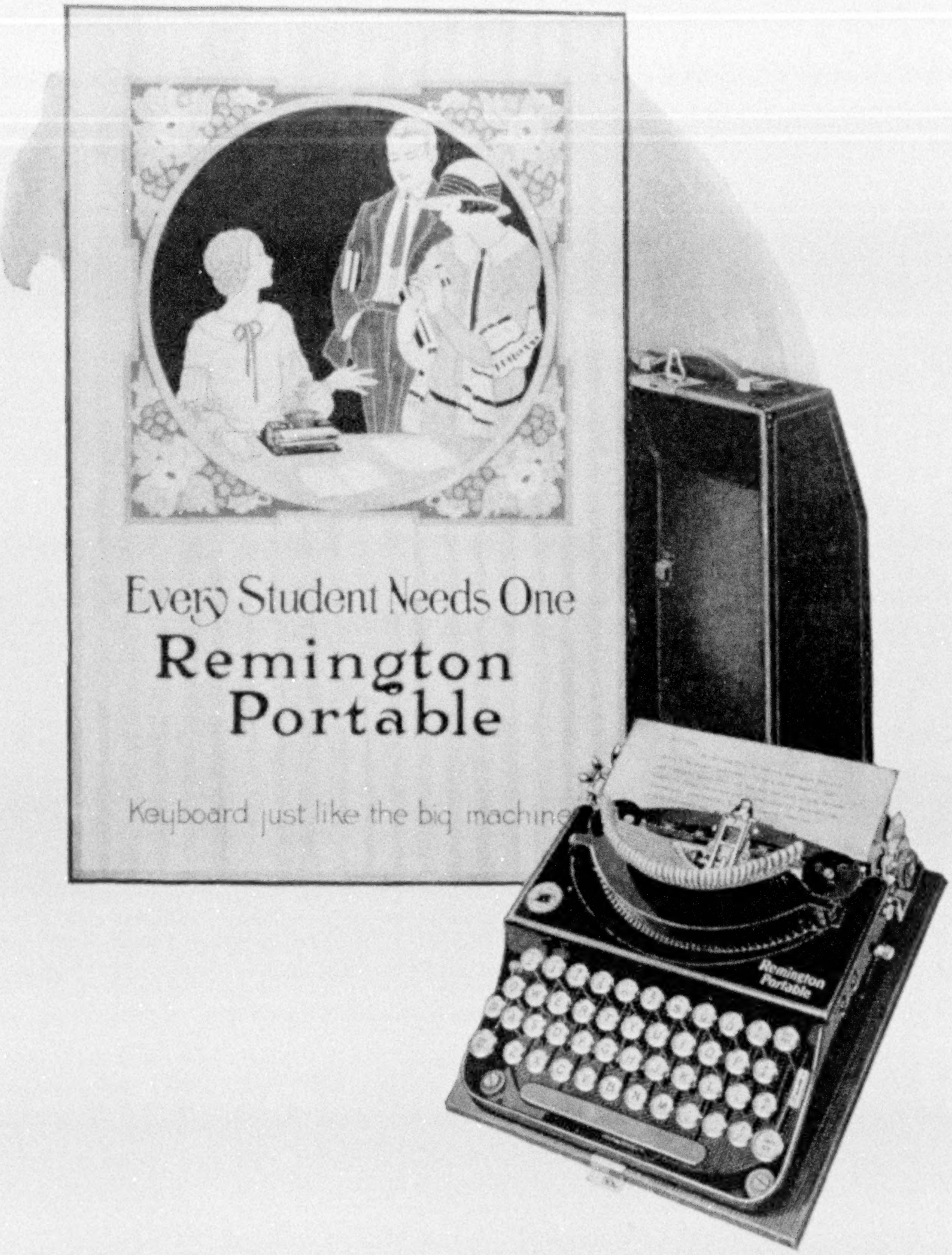

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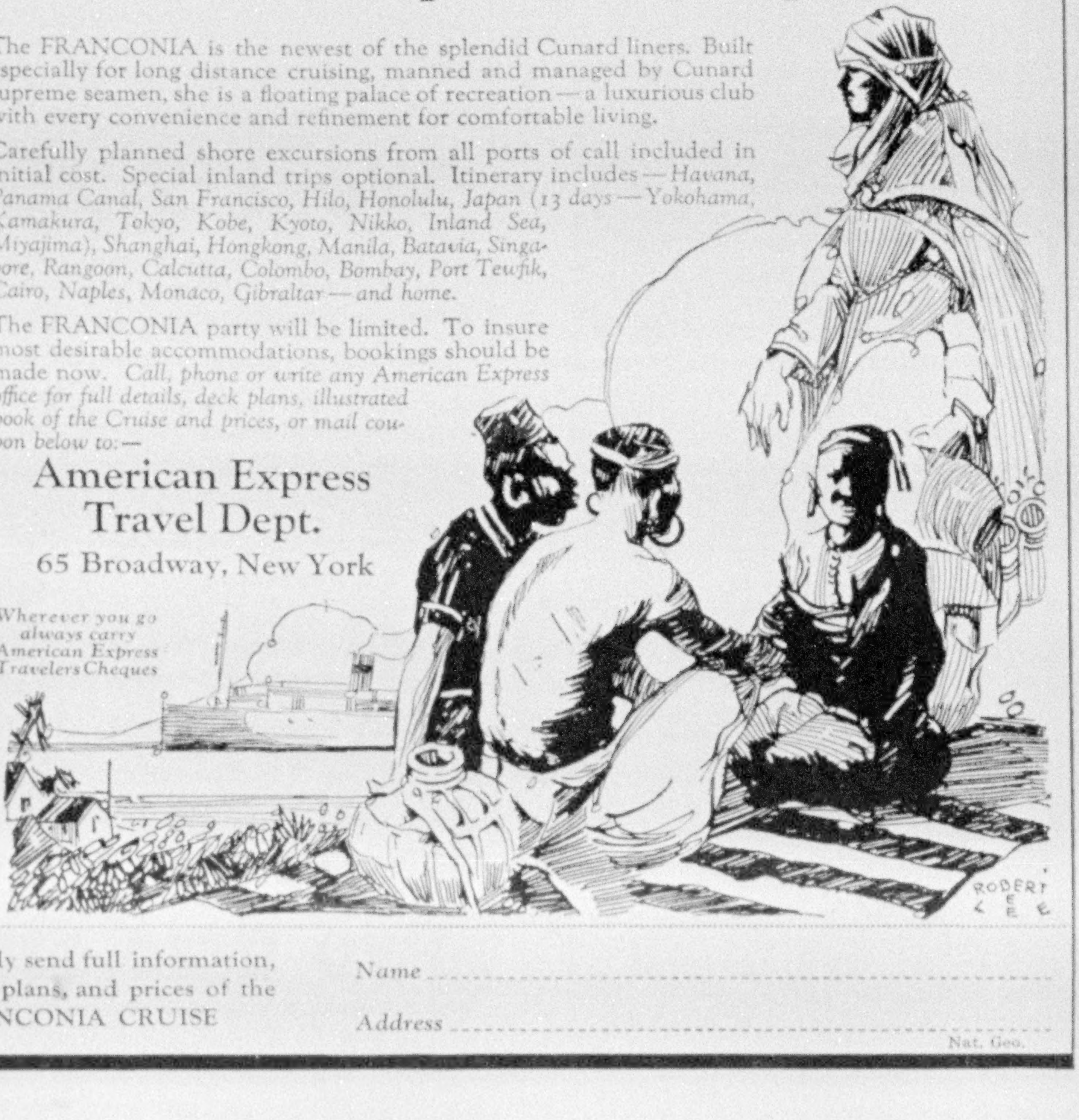

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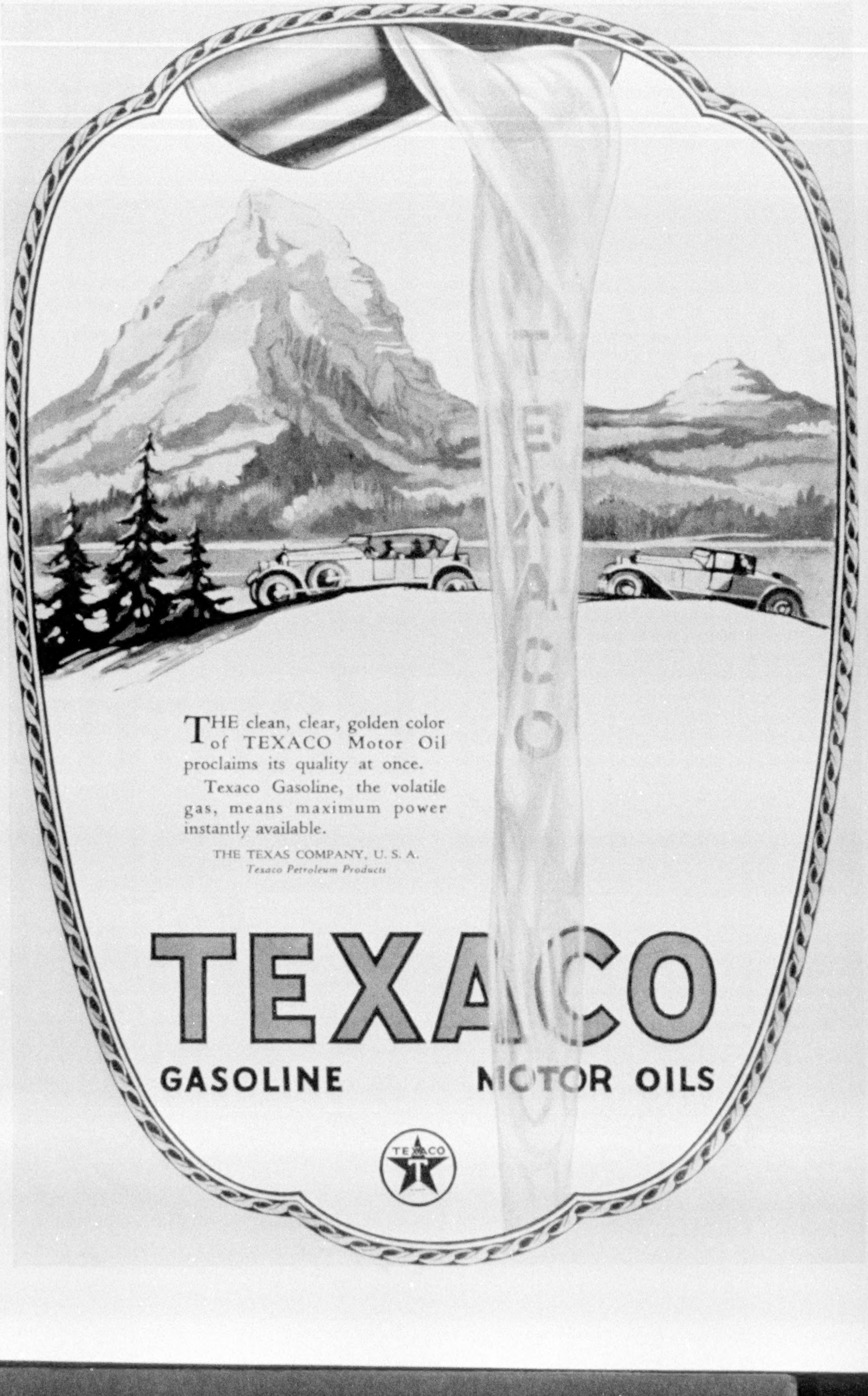
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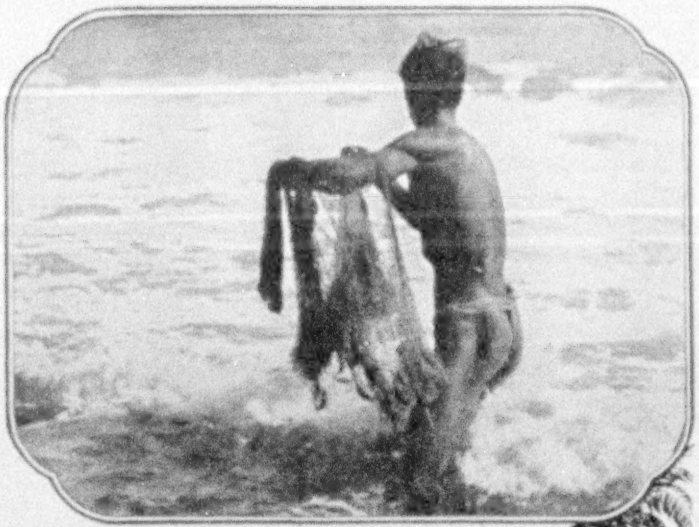

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Play in Waikiki's warm waters. Stand on Volcano Kilauea's rim, watching the fiery lava flowing below. Golf, tennis, deep-sea fishing, motoring and all other outdoor pastimes. Sleeping valleys wrapped in mist and rainbows; color-saturated gardens dreaming in the sun; forests of flowering trees and jungles of giant ferns where reptiles, poisonous insects and fever are unknown.

The cost includes first-class round-trip fare from the Pacific Coast and all sightseeing expense. The voyage is one of rare delight, 5 to 8 days direct from Vancouver, B. C., Seattle, San Francisco or Los Angeles, over warm, peaceful seas in ocean liners with every modern comfort. Round trip can be made in as little as three weeks, though most visitors remain longer. Good, ample hotel accommodations and motor roads on all islands. Frequent steamer service for inter-island cruises.

With all the exotic fascination of the South Seas, Hawaii is a territory of the United States, having the same laws, language, customs, conveniences. An ideal land in which to own a home and spend all or part of every year.

Go NOW to your nearest travel agency and arrange for the trip; or fill, clip and mail the coupon below.

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858 Fort Street, Honolulu, Hawaii, U. S. A.

Send me your free, illustrated booklet, "Hawaii—Eternally Enchanting"; also latest issue of Tourfax, containing detailed information for visitors to the Islands.

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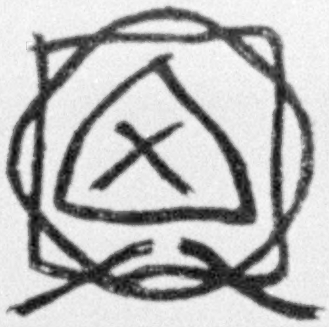


If you have ever laughed over that delightfully whimsical story of Frank Stockton's—"Rudder Grange"—you will remember the tramp who climbed the apple-tree to get away from Lord Edward, the ferocious watch dog.

The man of the house, you recall, came to see what the trouble was all about and the tramp promised "if you'll chain up that dog, and let me go, I'll fix things so that you'll not be troubled no more by no tramps." It was a bargain. The next day a curious mark was discovered cut in a tree at the end of the lane. No tramps appeared that summer.

Weeks later the man noticed another tramp looking at the mark on the tree. He bribed the hobo to tell him what it meant. And he learned that he had been branded as "a mean, stingy cuss, with a wicked dog" and it was "no good to go there."

* * * *

Every shop, every factory, every business has its mark—so that those who know the signs may read. It is the mark given it by its employees. Be sure of this: there is no way to escape the mark that is deserved—whether good or bad.

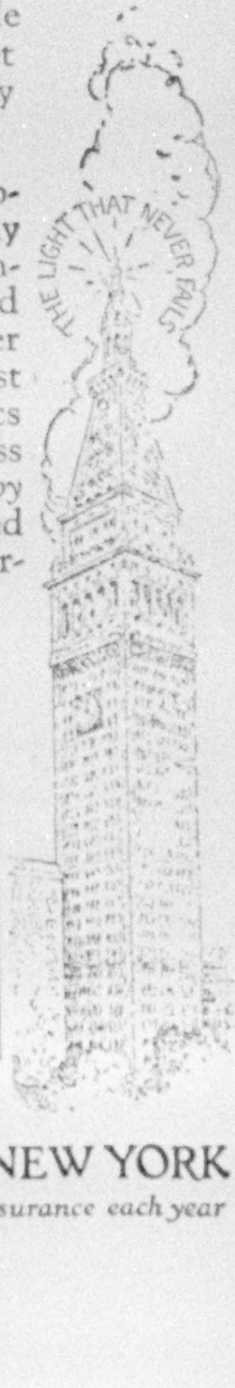
What makes the difference between the two? What gives one a bad mark and another a good mark? The difference is in the business vision and the human kindness of the men at the helm.

* * * *

Business today is undergoing a great change. In this new-day business outlook wise employers do not grind work out of their helpers as though they were machines. A new art has entered business—the art of coöperation.

The employer knows that every single one of his employees has four sides—physical, mental, social and financial. He provides better working conditions. He enables them to earn enough to live decently. He helps them to save. He enlists their intelligence as well as their skill. He knows that they need recreation. He sees that these wants are met and he goes still further by insuring their lives.

It is the dawn of a new tomorrow in business—the day when employers and employees begin to understand each other and plan together for mutual good. Men at last are learning that Humanics plays as great a part in business as Mechanics and that *happy workers* are the big concealed asset in many a business enterprise.


THE LIGHT THAT NEVER FAILS

The Metropolitan Life Insurance Company has searchers constantly at work in all parts of the United States and Canada, gathering data concerning various businesses. It is a giant magnet of business information—a great clearing house of better business ideas.

Every day the Metropolitan receives inquiries from employers for information on what industry is doing to bring employers and employees into closer sympathy by making business more *human*.

One phase of this new concept of business is the importance assumed by Group Insurance. It is life insurance at wholesale rates carried by an employer under one policy covering his employees.

A fine thing about Group Insurance is that it enables people whose physical condition will not permit them to pass a regular examination to be insured without medical examination. Think of the weight of worry this lifts from the men and women who need insurance most and without it must leave their families unprovided for.

Our Policyholders' Service Bureau has prepared reports covering many of the present day business problems—factory management, safety devices, stock purchasing and profit-sharing plans, housing, sanitation, factory routing, etc. Valuable information of this kind is at your disposal and will be mailed on request.

HALEY FISKE, *President.*

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Townsend

Because of the merit of his interpretations and the beauty of his voice, Werrenrath ranks among the great artists of today, and he is a Victor artist because his Victor Records exactly parallel his public performances. Among his twenty-two Victor Red Seal Records are:

	Single-faced		Double-faced	
Gypsy Love Song (from "The Fortune Teller")	64897	$1.00	844	$1.50
Duna	64863	1.00		
Herodiade—Vision Fugitive	74610	1.50		

WERRENRATH—Victor Artist

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Being a Victor artist not only means making Victor Records but approving them before they are issued. That Alda has fifty-one numbers in her Victor repertoire is convincing evidence of the great soprano's confidence in the fidelity of Victor Records. Hear these selections:

	Single-faced		Double-faced	
Ave Maria (with Elman)	89129	$1.75	8001	$2.50
Angel's Serenade (with Elman)	89130	1.75		
Carissima	66036	1.00	897	1.50
Daddy	66152	1.00		
Deep River (with Orpheus Quartet)	64687	1.00	527	1.50
By the Waters of Minnetonka	64908	1.00		

ALDA—Victor Artist

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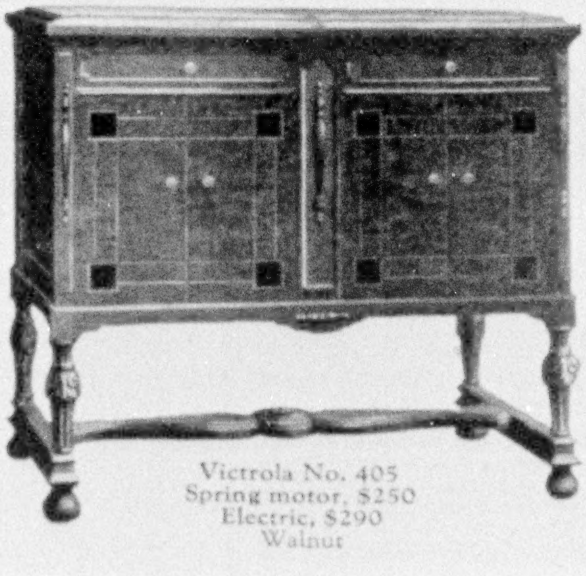
Heifetz is numbered with the really great among violinists. Every one of his thirty-six records is a perfect transcription of his art—and for that reason Heifetz is a Victor artist. Some of his records are:

	Single-faced		Double-faced	
Nocturne in E Flat	74616	$1.50	6156	$2.00
Symphonie Espagnole—Andante (Fourth Movement)	74646	1.50		
La Ronde des Lutins	74570	1.50	6159	2.00
Scherzo Tarantelle	74562	1.50		
Valse (from "Serenade for String Orchestra")	74635	1.50	6155	2.00
Serénade Melancolique	74711	1.50		

HEIFETZ—Victor Artist



Victrola No. 405
Spring motor, $250
Electric, $290
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It does make a difference when Victor products are *used together*—play the above Victor Records on this Victrola and note the superior tone quality. The Victrola No. 405 is fully equipped with the Victor tapering tone-arm, goose-neck sound-box connection, improved Victrola No. 2 sound-box and the simple, reliable Victor motor. Cabinet of highest grade materials. Carving done by hand. The Victrola is a purchase for a lifetime—it is built to last and to give lasting satisfaction.

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Victrola

"HIS MASTER'S VOICE"

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Victor Talking Machine Company, Camden, N.J.

VOL. XLIV, NO. 4 WASHINGTON OCTOBER, 1923

THE NATIONAL GEOGRAPHIC MAGAZINE

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THE AUTOMOBILE INDUSTRY

An American Art That Has Revolutionized Methods in Manufacturing and Transformed Transportation

BY WILLIAM JOSEPH SHOWALTER

AUTHOR OF "THE PANAMA CANAL," "HOW THE WORLD IS FED," "INDUSTRY'S GREATEST ASSET—STEEL," "COAL—ALLY OF AMERICAN INDUSTRY," "AMERICA'S AMAZING RAILWAY TRAFFIC," ETC., IN THE NATIONAL GEOGRAPHIC MAGAZINE

The following article presents a careful survey of the economic consequences of the development of the motor vehicle and a layman's impressions of the highly technical automobile manufacturing industry. The latter were gained during months of observation and inspection in the largest automobile factories in America, under the guidance of automotive engineers and manufacturing superintendents.—THE EDITOR.

WITH thirteen million motor cars and trucks now running on the roads of the United States, and with the annual demand for new ones in excess of three millions, America is both literally and figuratively "stepping on the gas" in the making of transportation history.

A quarter of a century has brought a development in the automobile industry that has outrun the dreamers, confounded the prophets, and amazed the world.

In 1898 there was one car in operation for every eighteen thousand people, each of them a hybrid creation secured by crossing a bicycle with a buggy, and installing in the product a noisy, sputtering little engine that startled the people in the streets and sent the horses on the highways into panic (see pages 348 and 349).

To-day there is one motor vehicle to every eight people, and the worst of them is a marvel of silence and service as compared with the best of its early predecessors.

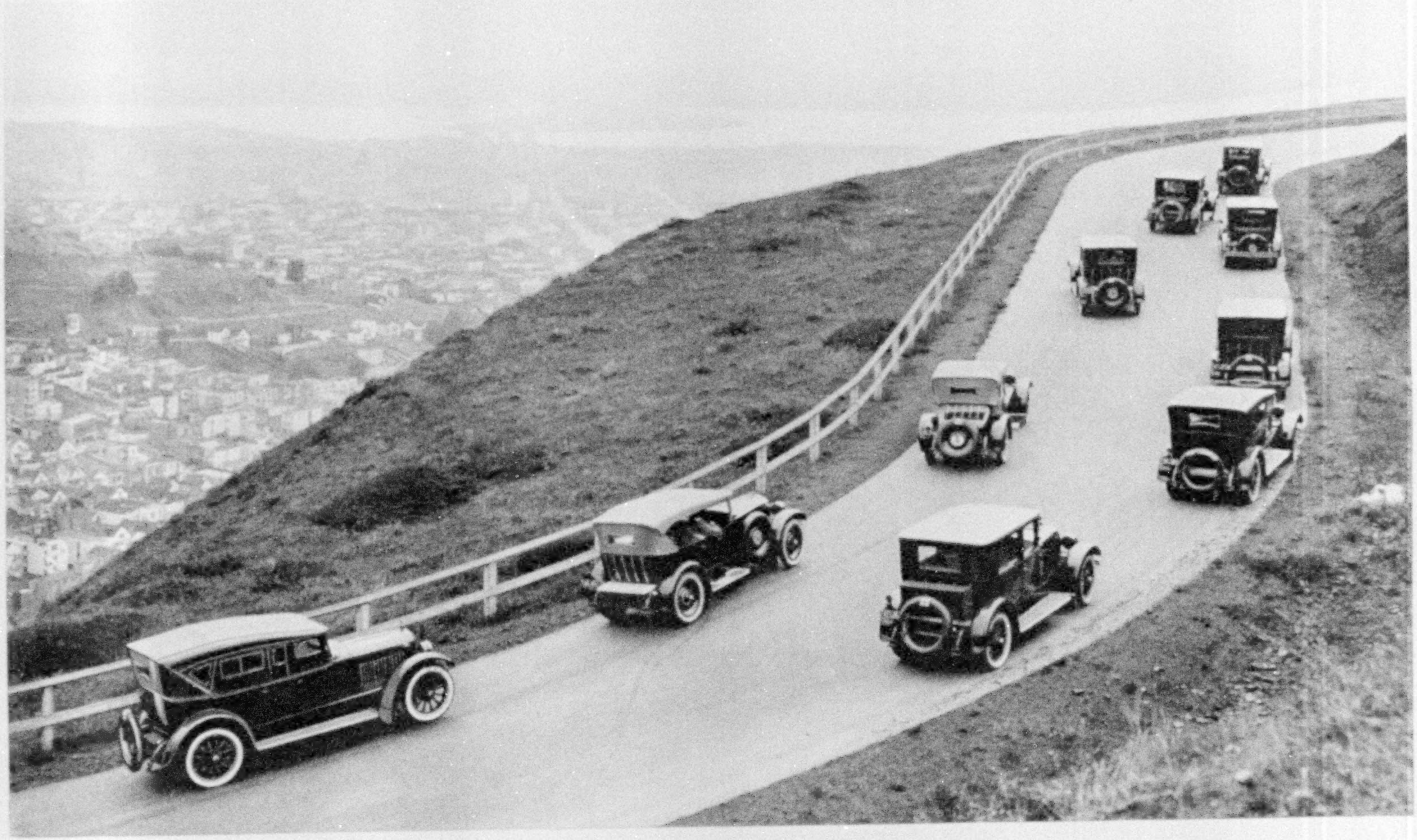
Thirteen million motor cars! Who can visualize them! Five for every freight and passenger car on all the railroads of the United States! Enough to carry half the people of America in a single caravan!

The Lincoln Highway, from the banks of the Hudson to the Golden Gate, is 3,305 miles long. To put them all on that highway, even in traffic-jam formation, would require that it be widened so that fifteen cars could stand abreast!

ROUND TRIP TO THE SUN EVERY 21 HOURS

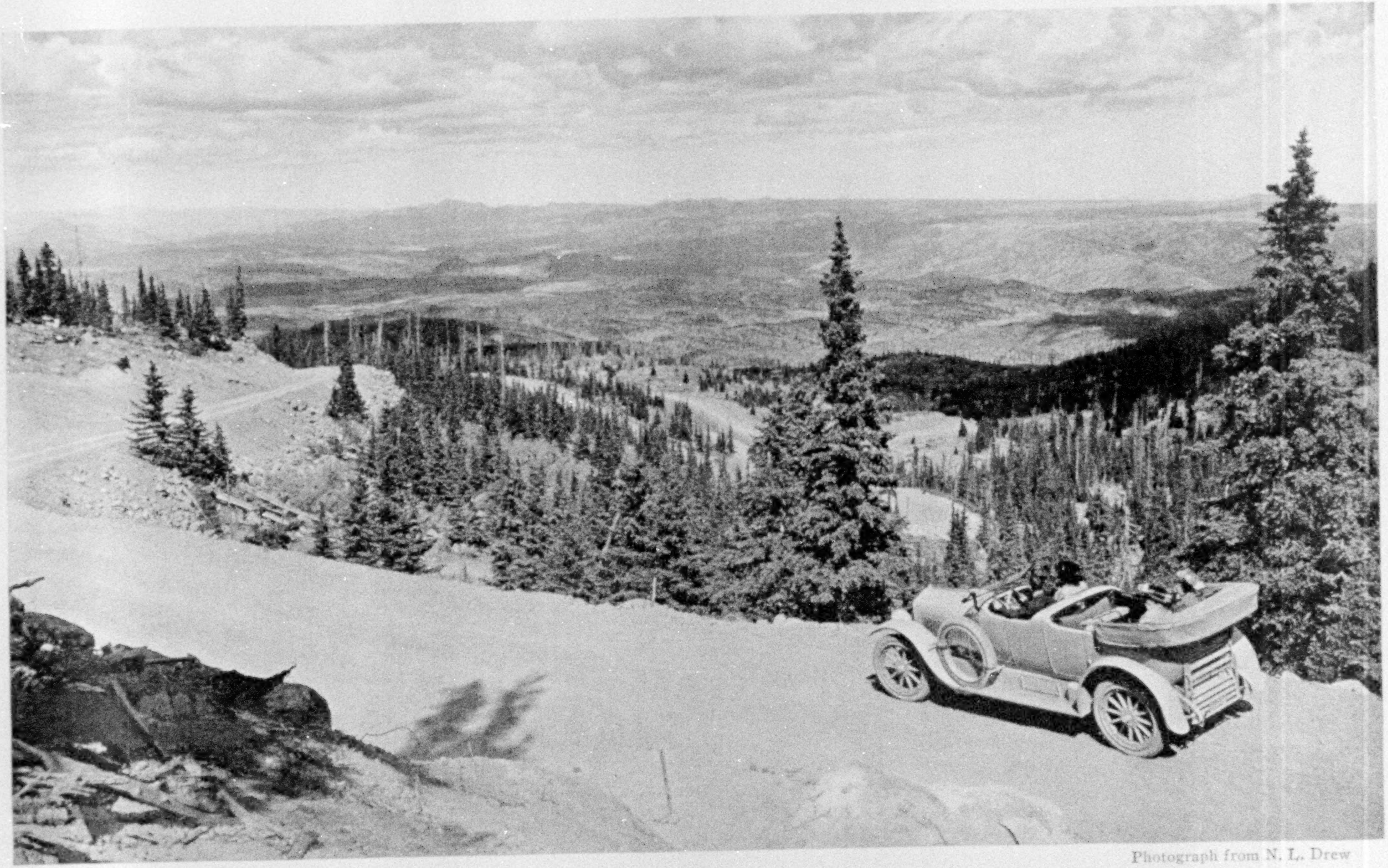
The service they render is proportionately large. Assuming that the average car is operated only ten months in a year and runs only twenty miles a day, their aggregate travel amounts to seventy-eight billion miles annually.

Such a mileage figure being so vast, we might conclude that ten months a year



TEN OF A KIND TAKING THE TWIN PEAKS' GRADE ON HIGH AT SAN FRANCISCO

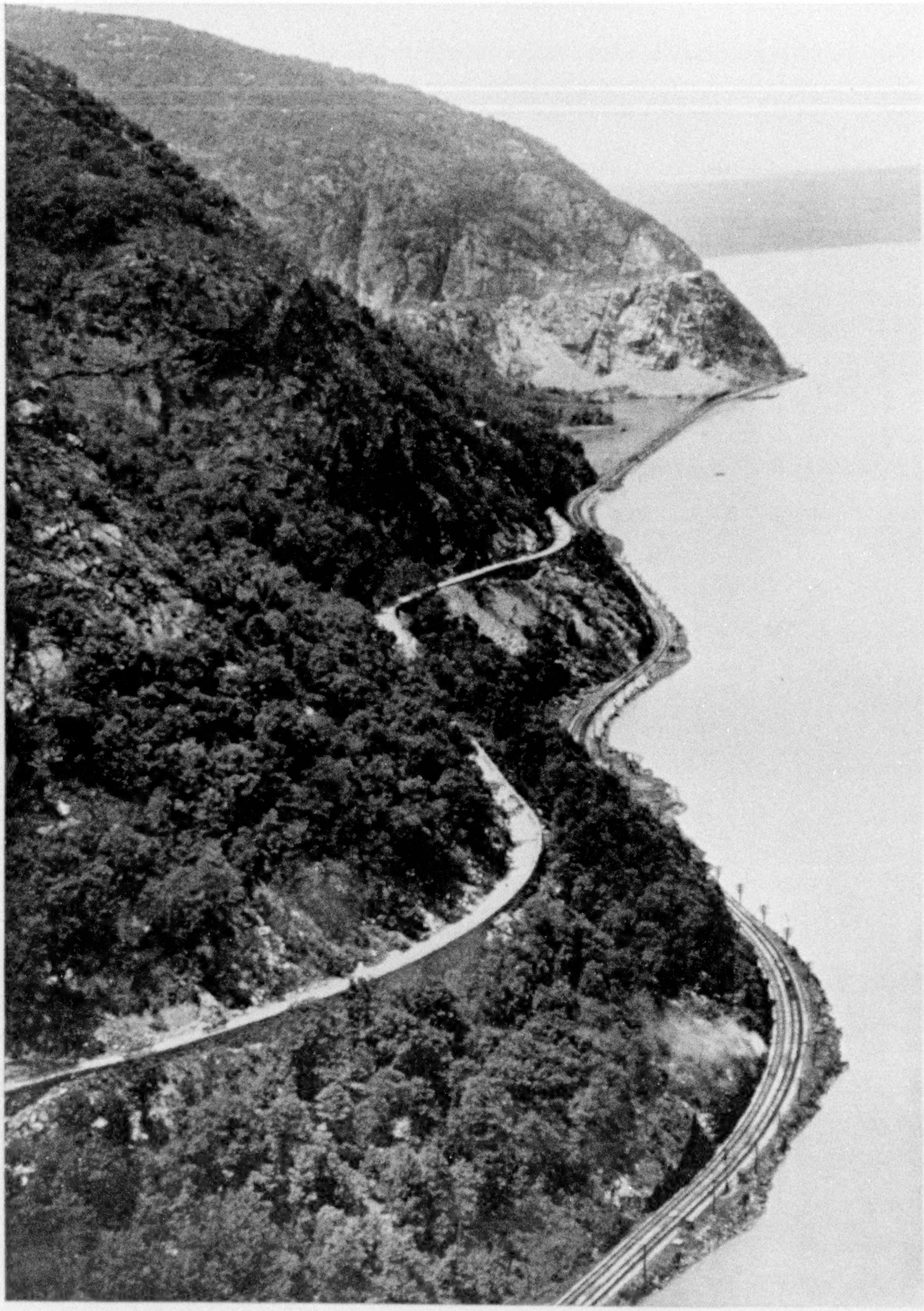
A San Francisco distributer decided to show the world what his cars could do on heart-breaking hills. Ten owners, one a woman, came to the scratch at the foot of the hill and not a gear was shifted after the start. The power of the American-built motor represents an outstanding engineering achievement.



Photograph from N. L. Drew

DRIFTING DOWN THE MOUNTAIN SIDE ON THE PIKES PEAK HIGHWAY

In no other way is the relegation of the horse from the streets and highways of the country more strikingly attested than in the decadence of the horse-drawn-vehicle industry. In 1914 the output of horse-drawn vehicles was valued at $131,000,000. In 1921 it had declined to $42,000,000—a slump of 67.8 per cent in seven years.



© Major Hamilton Maxwell

A SECTION OF THE STORM KING HIGHWAY BETWEEN CORNWALL AND WEST POINT, NEW YORK

It is such scenery as this that has drawn millions of motorists and their families into the great American out-of-doors and brought rejuvenation to tired nerves and sluggish bodies.

A PICTURESQUE PIECE OF ROAD-BUILDING ON SIGNAL MOUNTAIN, TENNESSEE

and twenty miles a day overestimated the average car's performance, but both gas and tire data tend to justify an even greater mileage.

It is estimated that the gas consumption by the motor cars of the country will exceed six billion gallons this year. It is generally held that, taking every type of car, the average driver is able to coax fifteen miles out of each gallon of gas he puts into his tank. But even on the basis of thirteen miles per gallon, a little arithmetic gives the enormous total mentioned above.

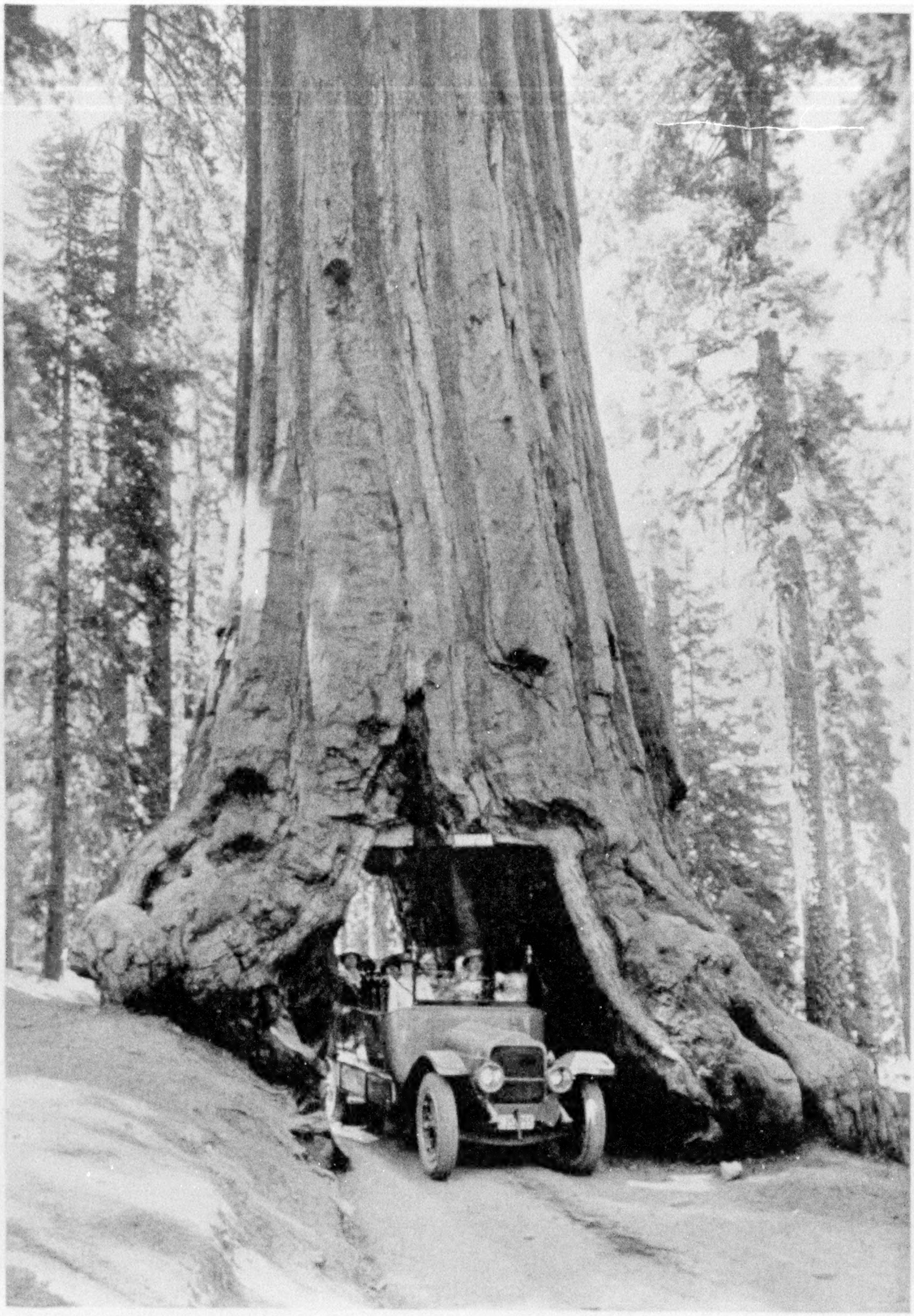
It is also believed that the average tire, fabrics and cords, delivers more than 8,000 miles of service. On the basis of the number of tires put on automotive wheels annually, the aggregate motor-car mileage would be eighty billions.

Three times as many motor-miles on the highways as car-miles on the railways is a marvelous record for so youthful a competitor of rail transportation.

Counts at the New York City ferries and elsewhere indicate that the average car carries 2½ passengers. This means that more than thirty million people take to automotive wheels every day, or more than nine billion annually—eight times as many as are carried by all the railroads.

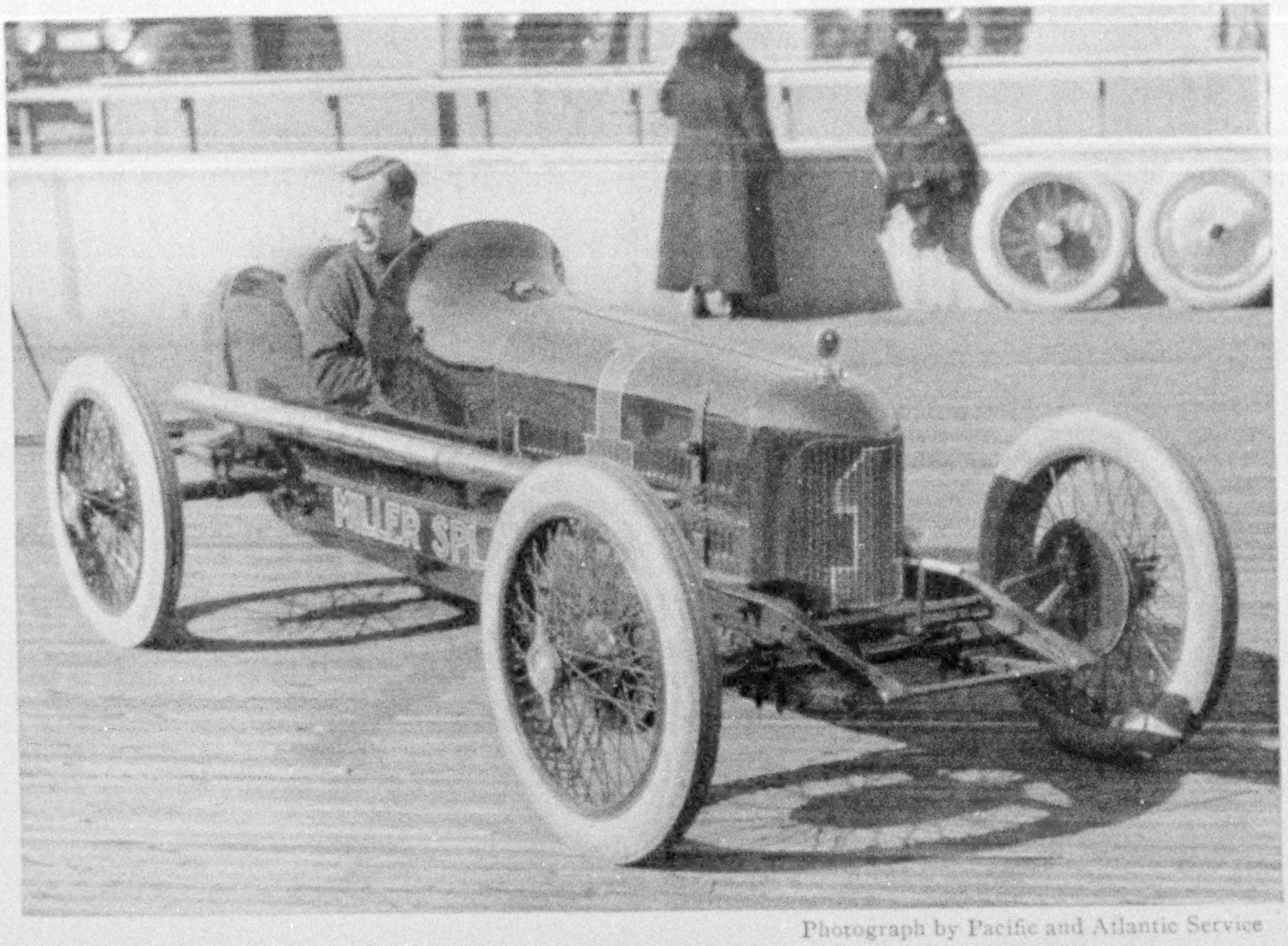
The transformation in the lives of the people which these figures indicate stands almost, if not quite, unparalleled in any quarter of a century of human existence.

Starting out as a plaything, transformed into a luxury, and then becoming, in turn, a definite element in our standard of living, the motor vehicle has assumed the rôle of a highly efficient factor in our



MOTORING THROUGH THE FAMOUS WAWONA TUNNEL TREE, MARIPOSA GROVE, CALIFORNIA

When Carl G. Fisher suggested the Lincoln Highway and Henry B. Joy sponsored it, they started a development that has done a vast service in opening up the national parks to the American motoring public and to the general cause of good roads. Roy D. Chapin followed their lead and established a scholarship in highway engineering at the University of Michigan—an idea that other universities have adopted.



Photograph by Pacific and Atlantic Service

A POWER MACHINE OF THE FIRST MAGNITUDE: A PRESENT-DAY TYPE OF RACING CAR READY FOR THE BIG RUN

Many of the racing cars are one-man vehicles, with a cockpit into which the driver can crouch in the event of a mishap. In some cars a sector is eliminated from the steering wheel rim to enable the driver to get his body completely into the cockpit, in the event the car rolls over.

transportation system, touching the lives and promoting the welfare of America as few developments in the history of any nation have done.

TRANSPORTATION THE LADDER OF CIVILIZATION

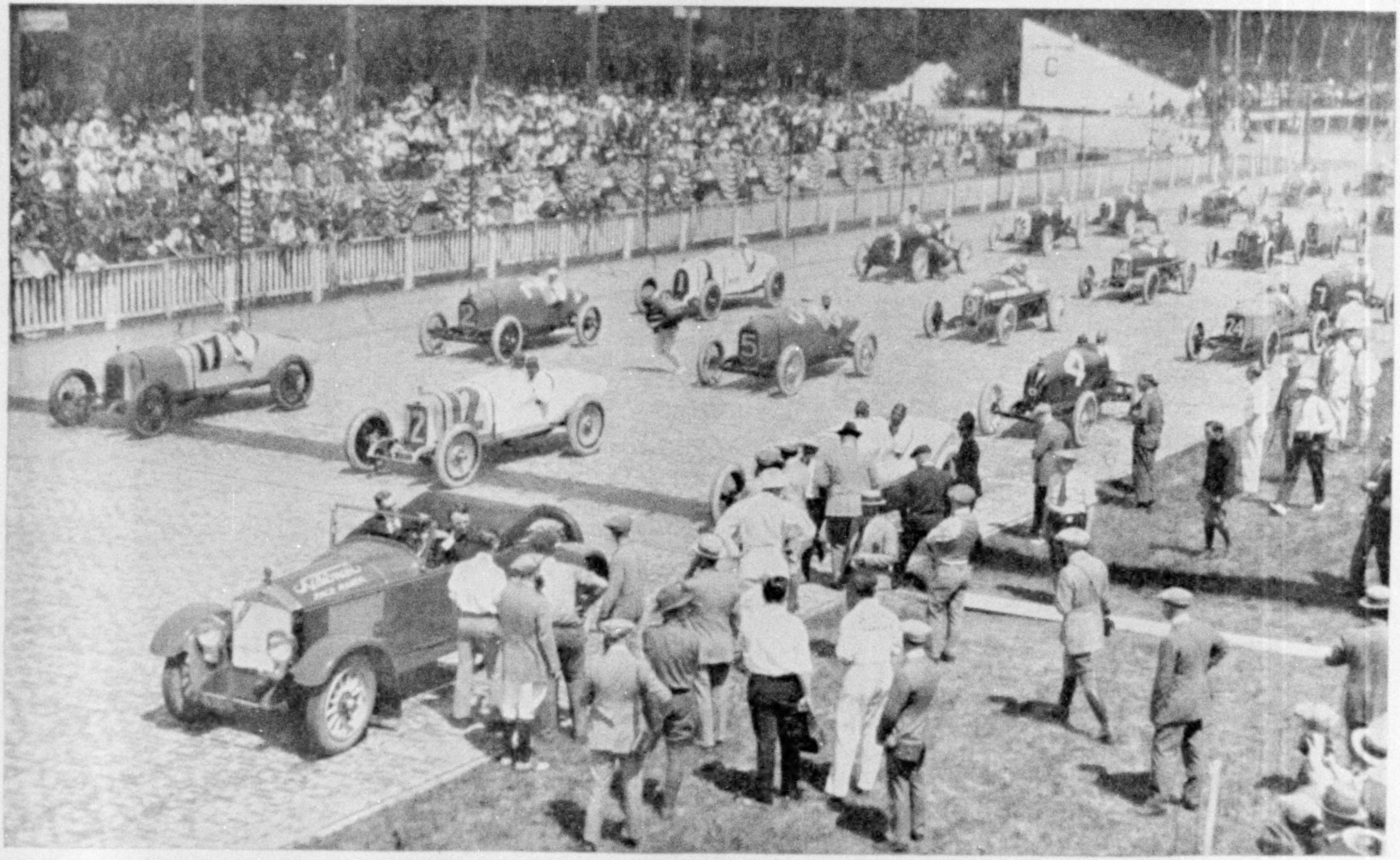
Transportation, some one has well said, has been the ladder upon which humanity climbed from a condition of primitive life to that of a finely wrought and complex civilization.

As the number of automobiles has grown, the wealth of the country has increased. In 1909 we had less than three hundred thousand motor vehicles in commission and the national income amounted to less than twenty-nine billion dollars. To-day, with our thirteen million registered vehicles, the national income is around sixty billion dollars.

Although we are, as a nation, according to Moody, the statistician, spending more for our automobile service than is being spent for railroad transportation, shelter, or heat and light—more, indeed, than for any other item in our national budget except clothing and meats—our savings-bank deposits and every other index of economic well-being tell the same story of the growth of our national wealth.

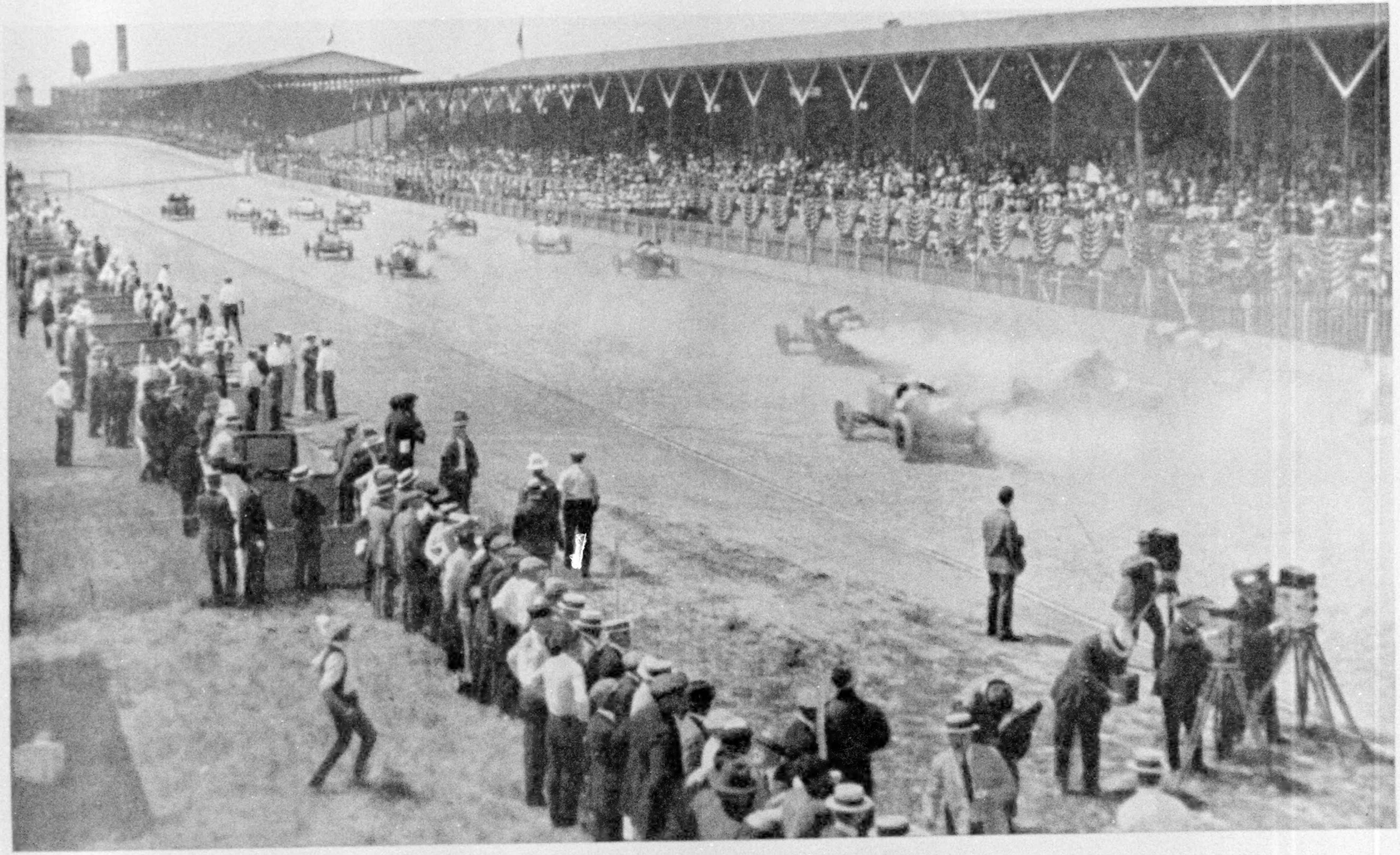
Economic readjustments are taking place on a major scale, and with increasing momentum, under the irresistible impact of automotive mileage.

Cities are spreading out. Long Island is built up for half its length to accommodate those who make New York the metropolis of America; so is New Jersey from Morristown to Long Branch and from Jersey City to the Empire State boundary at Suffern. Even Connecticut, as far as Stamford, Greenwich, and New Canaan, is peopled with those who work in Gotham by day and sleep in the country by night.



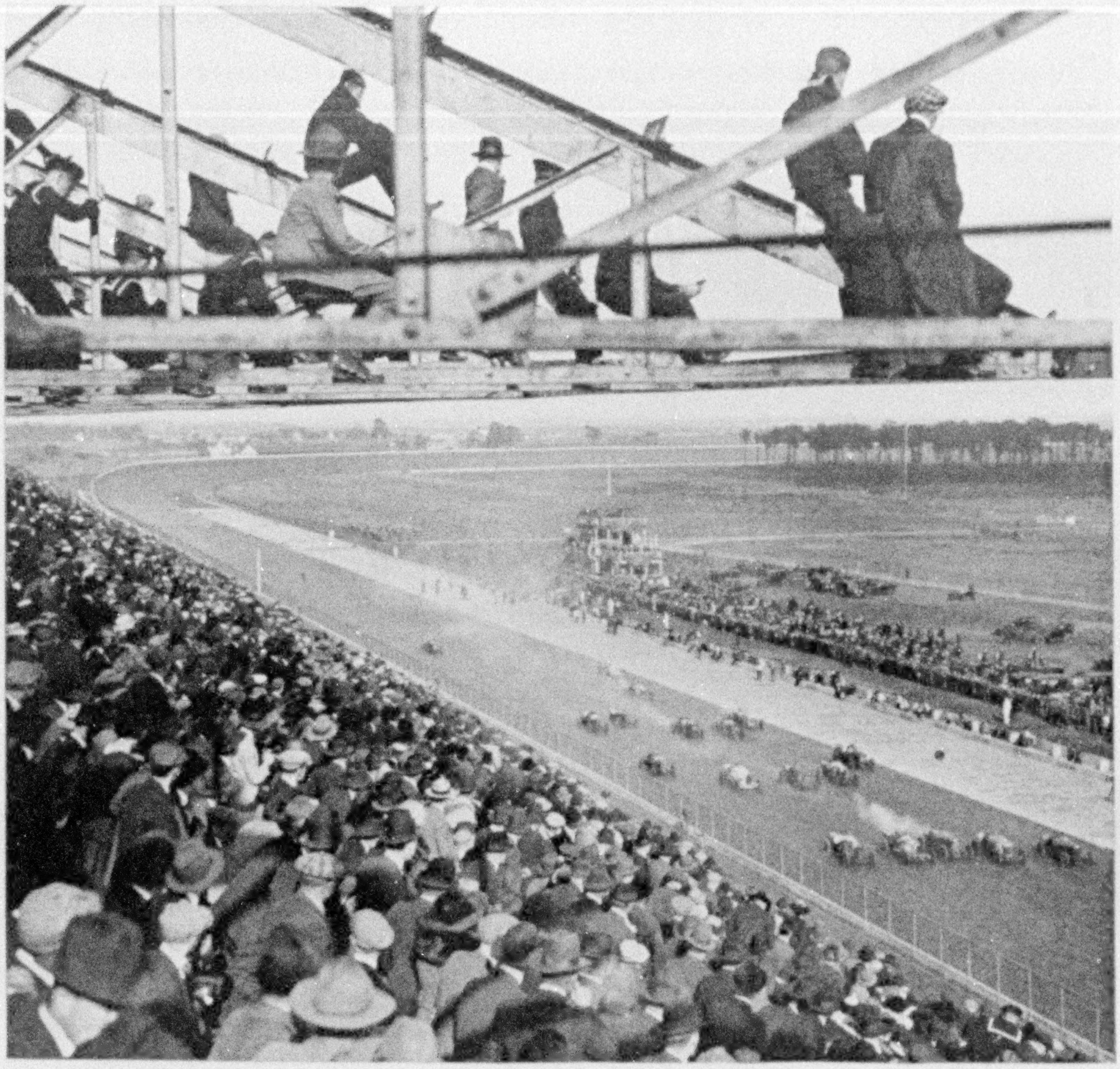
THE LINE-UP AT THE START OF THE SPEEDWAY 500-MILE TEST AT INDIANAPOLIS

"These terrific tests have always brought the engineering talent of the country together. Under the lessons learned there, cylinder displacement has been reduced, fuel economy has been evolved, and safety has been forged into every element of your car and mine, on the mighty anvil of a speedway and under the powerful hammer of high speed. Harmony, balance, dependability, tire mileage, and sturdiness have come from the flaming forge of a hundred miles an hour" (see text, page 384)



DOWN THE STRETCH WITH THROTTLES WIDE OPEN

No phase of motor-car development has brought more comfort to the car-owner than the evolution of tire dependability. In the big speedway races there is an amazing amount of skidding around the turns, and tires simply had to be improved to stand the grind. The long life that every motorist now finds in high-grade tires grew out of lessons learned in these grueling races.



Photograph by Paul Thompson

THE START OF THE HARKNESS TROPHY RACE AT THE SHEEPSHEAD BAY SPEEDWAY, NEW YORK

Where once the kings and queens of the turf thrilled the multitudes with the fleetness of horse flesh, now the finest creations of the automotive engineer's art flash around the course at a hundred miles an hour.

Chicago has the same story to tell, with its scores of consequential colonies, its dozens of outlying subdivisions. Philadelphia and San Francisco are but other examples of how men are coming to work in town and live in the country.

Not only in a residential way are cities undergoing a change, but also in a business way. The trek of branch banks far out beyond the business district is but one straw showing the direction of the transportation wind. The lack of parking space down town is making an ever-widening business district and new centers of commercial activity in every major urban community. The era of down-town crowding is forcing the future to change radically our orthodox type of commercial concentration.

EVER-BROADENING RURAL HORIZONS

A similar transition is occurring on the farm. No longer are the farmer's children isolated. They can find their diversion in the pleasures of urban life after the day's rural tasks are done.

High schools are spreading out through the rural districts, and the general substitution of systematic secondary education for the little red schoolhouse type of training is of vast moment to America.

Rural horizons are being pushed back.

The twenty miles that once represented a day's journey in the farmer's little world are now less than an hour's spin.

The broadening experience that travel brings; the development of judgment and decision that automobile driving requires; the spread of mechanical knowledge that car maintenance entails; the demand for initiative and enterprise in those who would own and operate an automobile, are giving to the American people a training the value of which cannot be estimated in dollars and cents.

Many a wise leader of industry has sensed the significance of car ownership by his employees, and is encouraging them to buy homes where houses are detached and where they can own cars. The president of the Baldwin Locomotive Works has told his men that he wants all of them to have initiative enough to own cars.

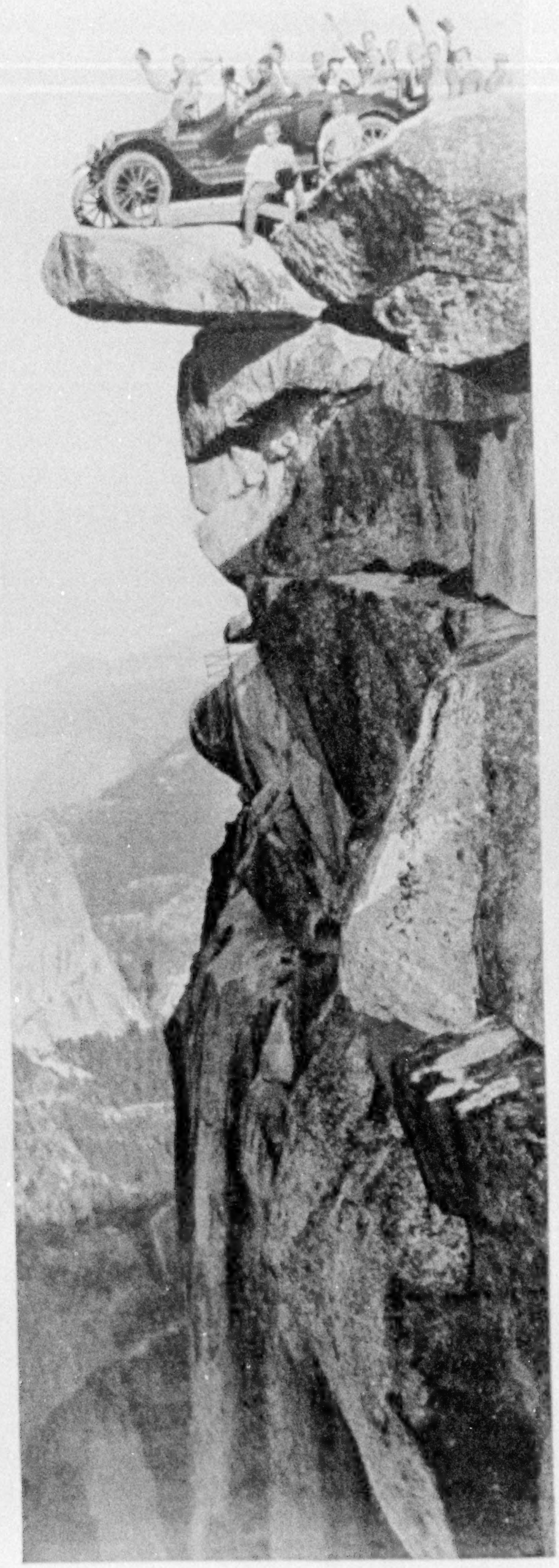
ELEVEN OUT OF EVERY THIRTEEN MOTOR CARS IN THE WORLD REGISTERED HERE

What people could appreciate and capitalize the advantage of the motor car so well as those of America? Their wealth is more widely distributed than that of any other nation; their average income is equaled nowhere else on the planet; furthermore, they have an unexcelled genius for quantity production. It is these facts that are responsible for eleven out of every thirteen motor vehicles in the world being operated on American roads, and for twelve out of every thirteen produced in a given period being Yankee-made.

Surveying motor-car registration, we find that South Carolina has more cars than Australia or Argentina; that Kansas has more than France or Germany; that Michigan has more than Great Britain and Ireland.

Indeed, New York, Pennsylvania, New Jersey, and Maryland, with a combined population smaller than Poland, and with an aggregate area more limited than New Mexico, have more automobiles in service than the whole world outside of the United States.

Even the District of Columbia has more motor vehicles than Austria, Belgium, Brazil, South Africa, China, Cuba, Czechoslovakia, Denmark, India, Japan,



AT THE END OF THE TRAIL: GLACIER POINT, YOSEMITE PARK, CALIFORNIA

Through the automobile, the American people have broken the bonds that formerly tied them to narrow localities.

Photograph by Brown Brothers

A CROSS BETWEEN A BICYCLE AND A BUGGY, IN THE EARLY DAYS OF THE AUTOMOTIVE INDUSTRY

Haynes, Ford, Duryea, Winton, Olds, and Apperson are names that will live as the founders of a vast industry who builded better than they knew.

Jugo-Slavia, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Rumania, Russia, Spain, Sweden, or Switzerland.

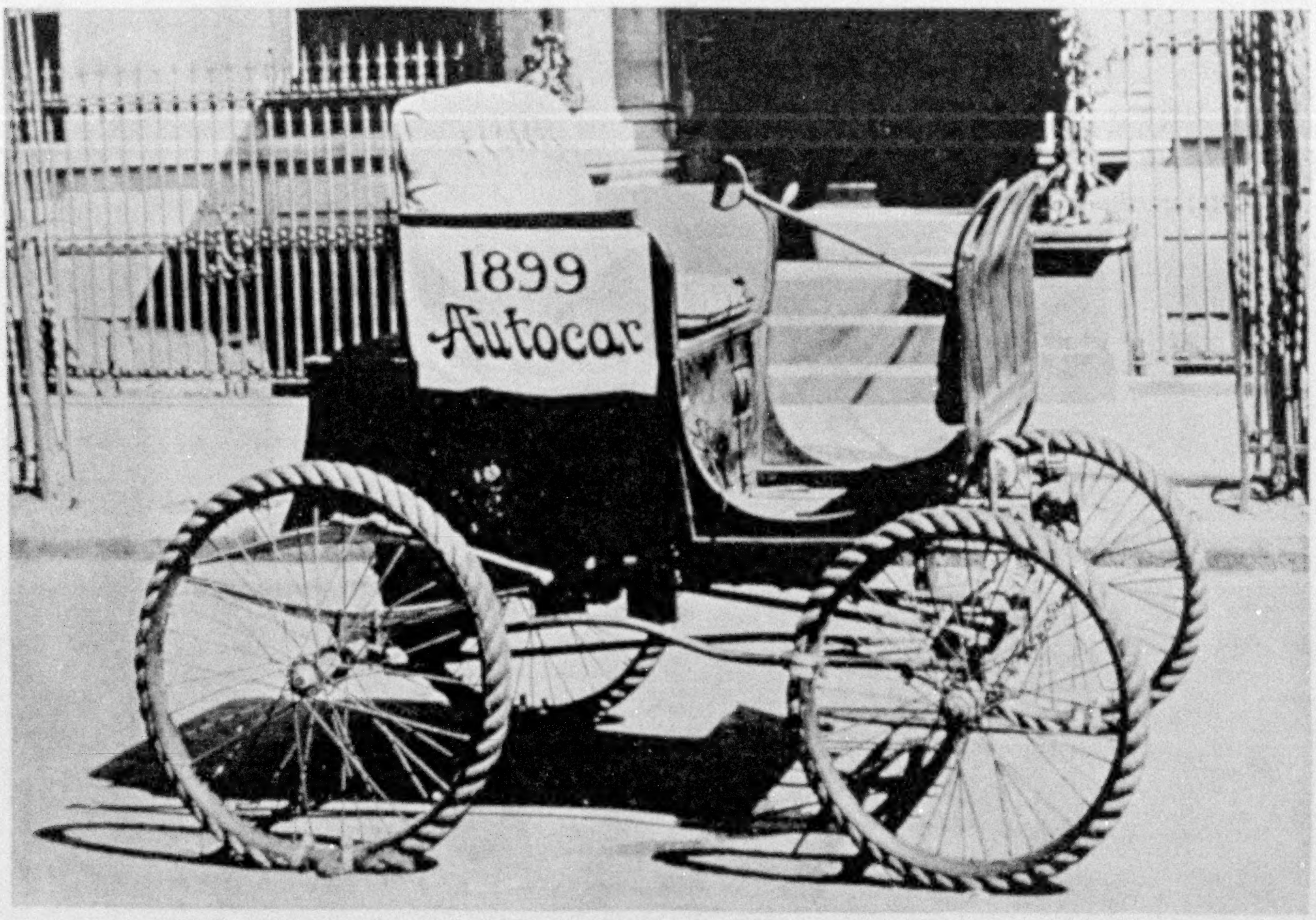
In a group of twenty-eight major cities of the country, there are more cars stolen annually, even, than are used in Austria, Belgium, Japan, or Mexico.

The insatiable demand for new cars, in spite of the tremendous number already in service, is disclosed by the fact that many more will be called into commission this year than were built from the birth of the industry up to the end of 1915.

Available figures indicate that the total car sales for the year will approximate five millions, including two million used vehicles. This means that one family out of every four in the country annually figures in an automobile transaction.

WHEN WILL THE POINT OF SATURATION BE REACHED?

With such facts before them, men naturally pause and wonder how it can be that the long anticipated "point of saturation"—that is, the hour when the country's demand for new cars will be limited to replacements—is not reached.



Photograph by Brown Brothers

A ROPE-TIRED HYDROCARBON CARRIAGE OF THE 1899 TYPE

When Charles Goodyear accidentally dropped a lump of his rubber compound on a hot stove, he little dreamed of the forty million cord and fabric tires that would annually rise out of his discovery, or of the motor-car industry made possible thereby.

All the economists have been predicting its arrival for years. A decade and a half ago it was learnedly urged that the wealth of the country could never support more than two hundred thousand new cars a year. A little later it was being said that when the registration reached the five-million mark it would slow down to the slight annual increase required for the growth in population.

But that mark was passed and the expansion continued, with ten millions as the limit beyond which it seemed impossible to go. To-day that limit has been exceeded and there are once more many considerations which would seem to indicate that the "point of saturation" is close at hand. Car registration is now up to the point where it is only a million behind the telephone listings of the country, only seven millions behind the total number of families, and even closer than that to the total number of dwellings.

Yet contrary to these considerations, and in spite of the warning from financiers that many people who can't afford them are buying cars, and in the face of the additional fact that 70 per cent of the cars being sold are bought on the deferred-payment plan, the demand goes on unchecked except as affected by seasonal conditions.

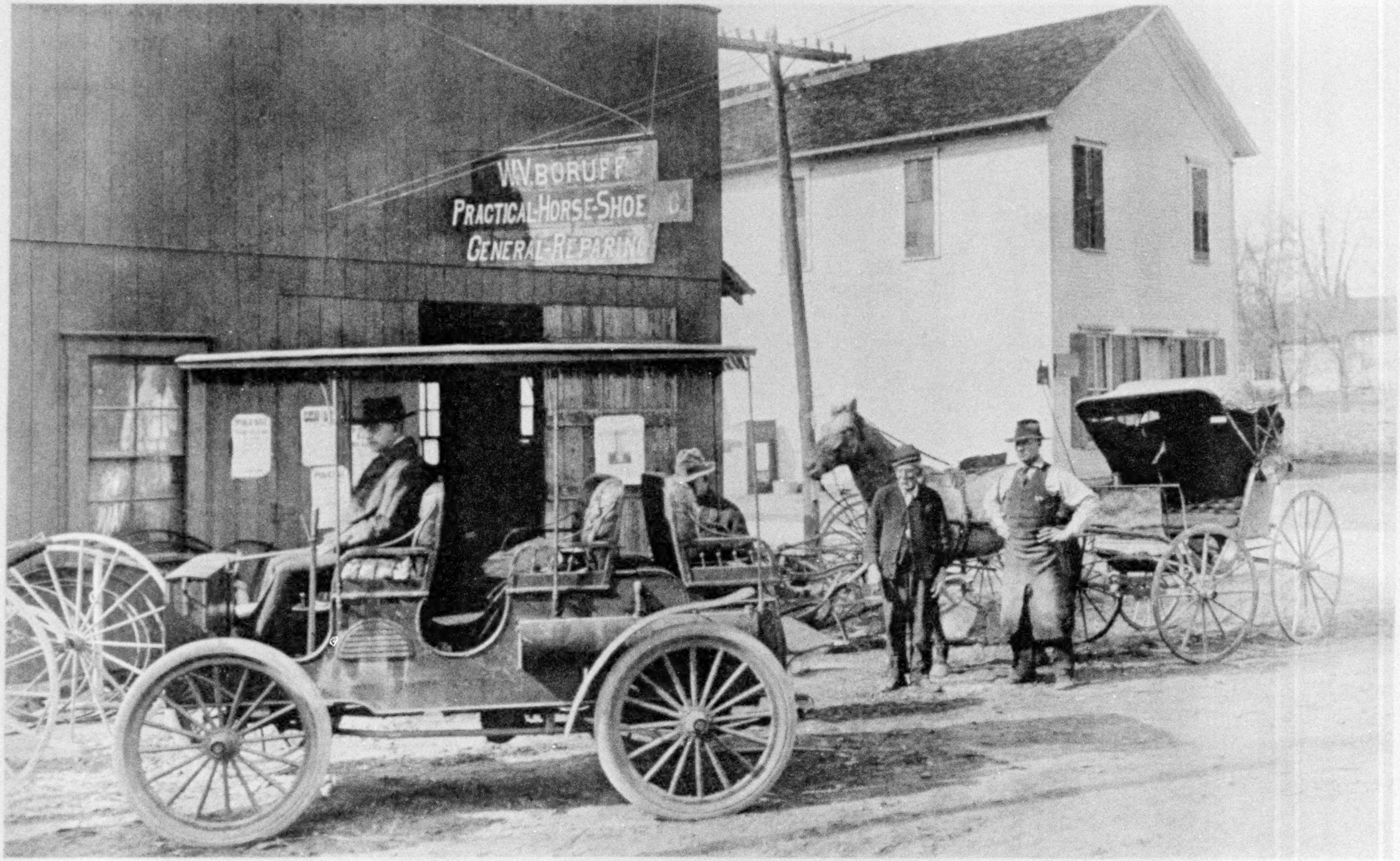
A study of Uncle Sam's expense account for motor-car transportation shows that it totals seven billion dollars annually. Men naturally wonder how we can go far beyond that, but they forget that for every dollar added to our national automobile transportation expenses we add several dollars to our national income.

WHO CAN AFFORD AN AUTOMOBILE?

An old-time, long-headed man in the automobile industry has a theory that seems to be the answer to the issue of who can afford to buy a car.

"I get tremendously tired of all this talk about this man and that man not being able to support an automobile," said he. "It's just like the question of whether a given man can afford to get married or

XUM

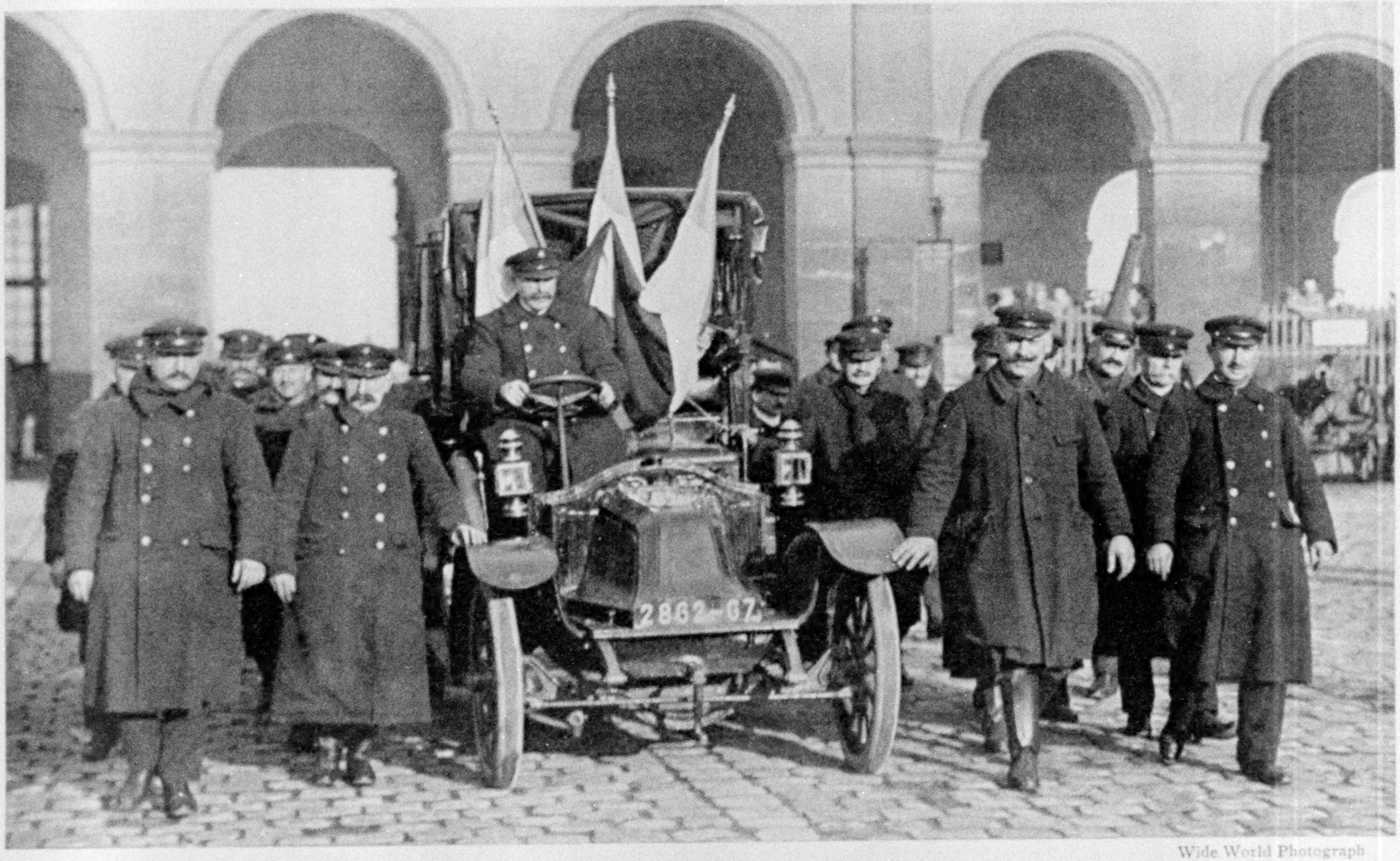

W.V. BORUFF
PRACTICAL HORSE-SHOE
GENERAL REPAIRING

Photograph by Brown Brothers

EXPERIMENTAL TRANSPORTATION TWO DECADES AGO

The blacksmith and the owner of a one-hoss shay survey with disdain the new-fangled machine which presumes to travel rubber-shod over rough highways. And for many seasons, before the day of perfected motor and of service station, it was the horse or the mule which pulled the new invention out of mudholes and sand beds when engine balked and tires subsided.

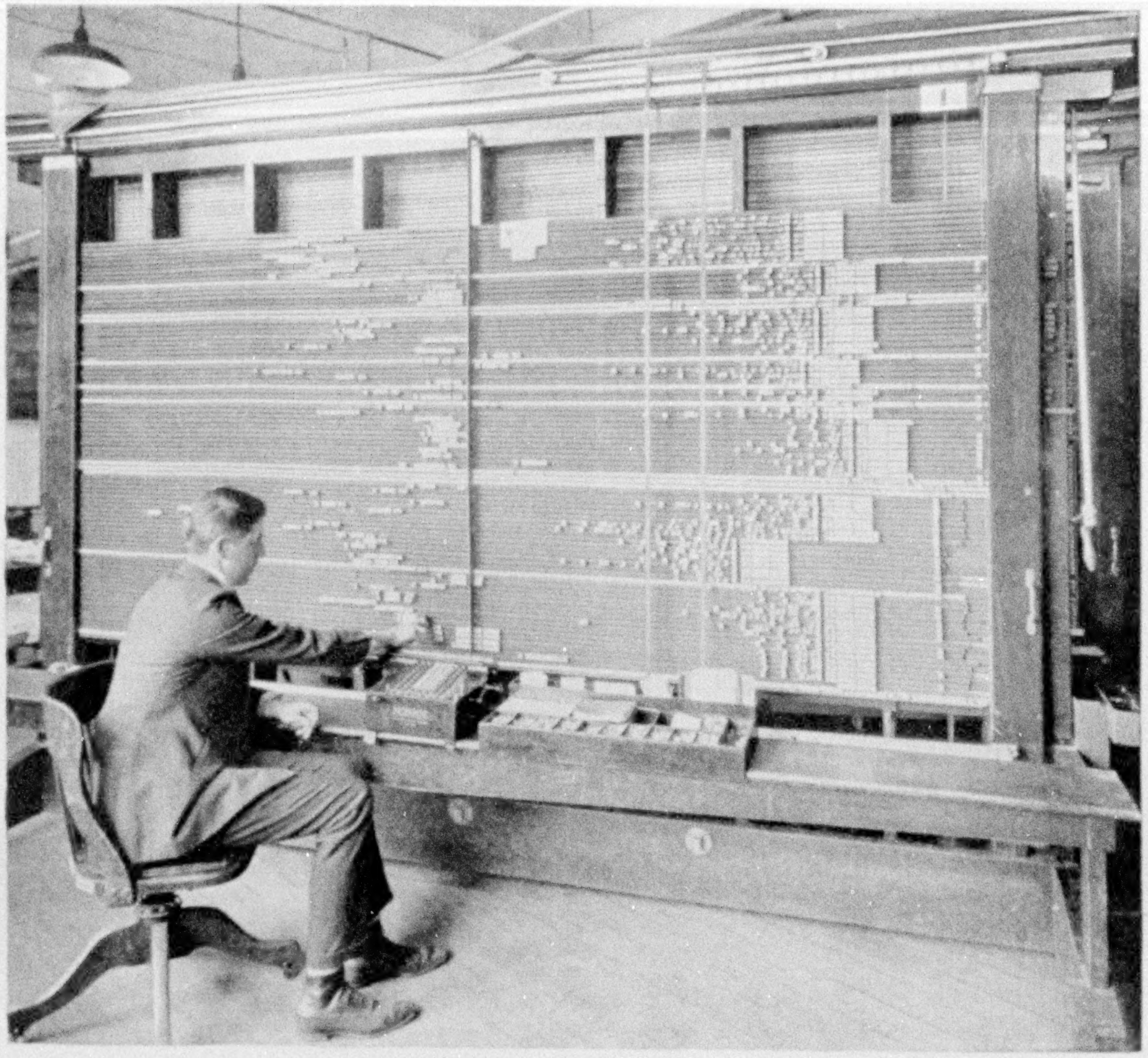
XUM



Wide World Photograph

ONE OF THE TAXIS THAT SAVED PARIS AT THE MARNE

This cab was recently driven to the courtyard of the Invalides, in Paris, where it is to take its place beside the railway coach in which Marshal Foch signed the Armistice.



THE DISPATCHER'S OFFICE IN AN AUTOMOBILE PLANT

These boards, in the production department of a major plant, control the passage through the factory of material and parts, bringing them together at the right time and showing the status of operations all the way through to the finished product.

not. One man, in whom only his bride has confidence, makes a success of matrimony and life. On the other hand, another man embarks on the matrimonial sea who is regarded as well fixed, and he makes a total failure of his venture."

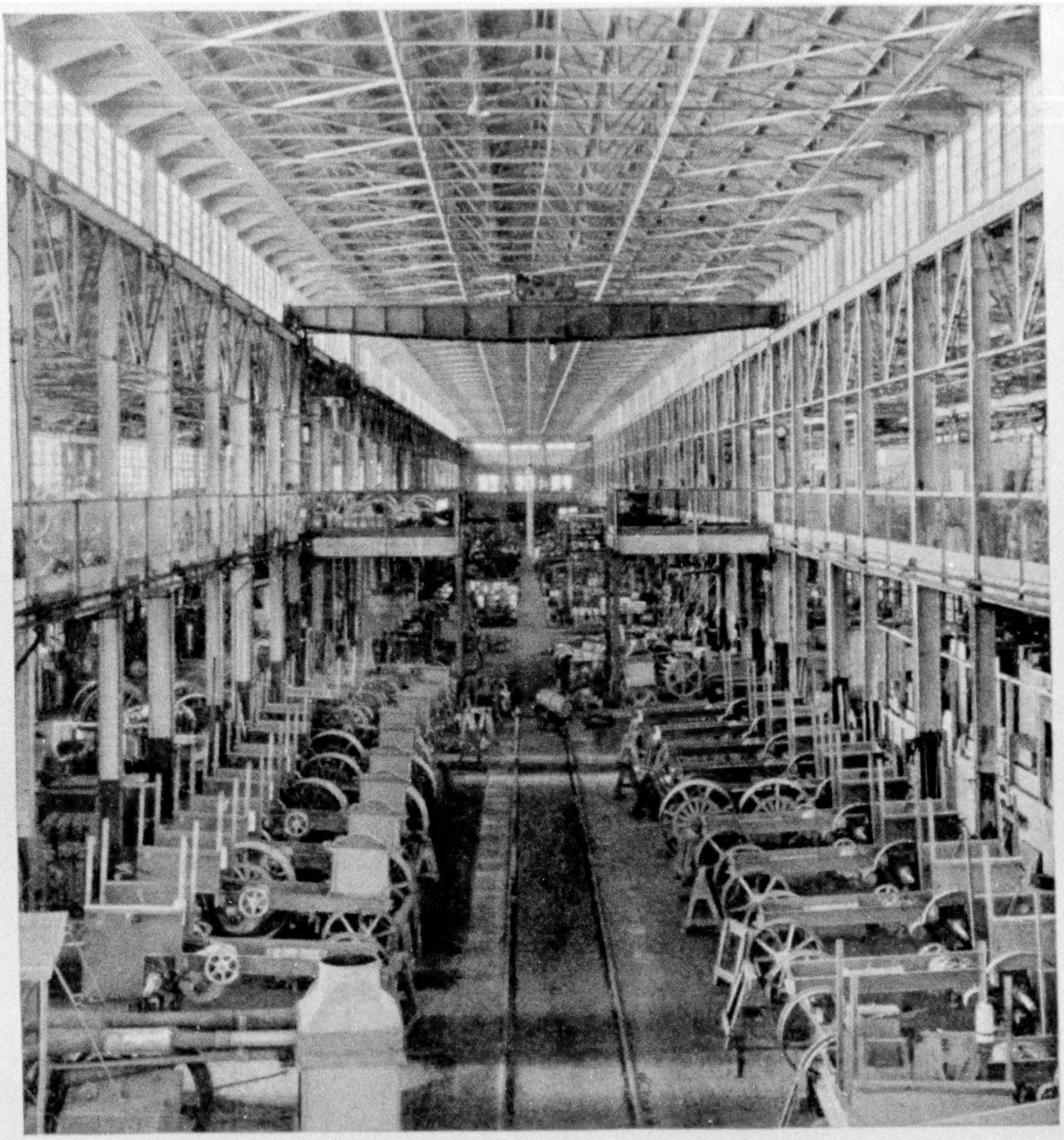
Many a man is "made" by marriage, and not a few are developed by automobile ownership. But just as matrimony enriches the nation, however much it costs in dollars and cents, so does transportation—and that is what the automobile is.

Many things are happening that promise to postpone our arrival at the "point of saturation," however much the signs indicate its nearness.

Graphs of prices and production show that price reduction has always served to widen the demand. Every fifty dollars' reduction in selling price opens up, according to the graphs, a new field of a million prospects.

The deferred-payment plan also widened the market tremendously for all cars, and now the much-discussed "five dollars down and five a week" scheme of the Ford Motor Company is enrolling hundreds of thousands of new customers.

But that plan, it seems, is not exactly what on its face it appears to be. The dealer is to use his judgment as to how many months these payments will have to continue before the customer gets his car. If the latter convinces him of his ability to go on paying, the car will be delivered after thirty weeks. Otherwise, the whole sum, even, may be required



THE INTERIOR OF THE MACHINE SHOP OF A BIG TRACTOR PLANT

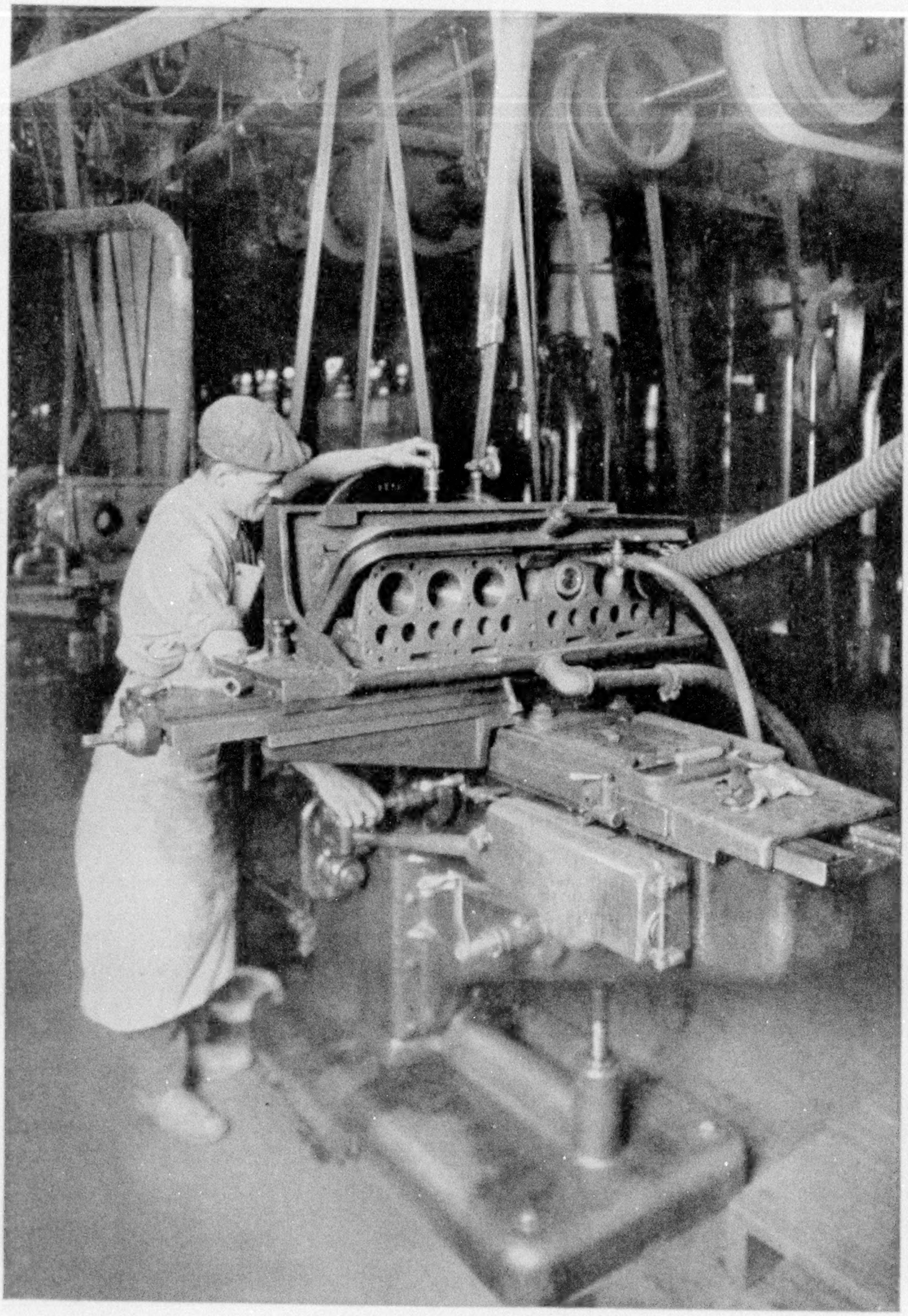
Quantity production is becoming as marked in tractor plants as in automobile factories. The Iowa State Agricultural College has found that it costs $100 a year to keep a farm horse, and that the average horse works 723 hours. A tractor will do the work of six horses, to say nothing of the human labor saved.

before delivery is made, and by that time the buyer will have had a pretty good lesson in thrift.

HUMAN EFFICIENCY AND THE AUTOMOBILE

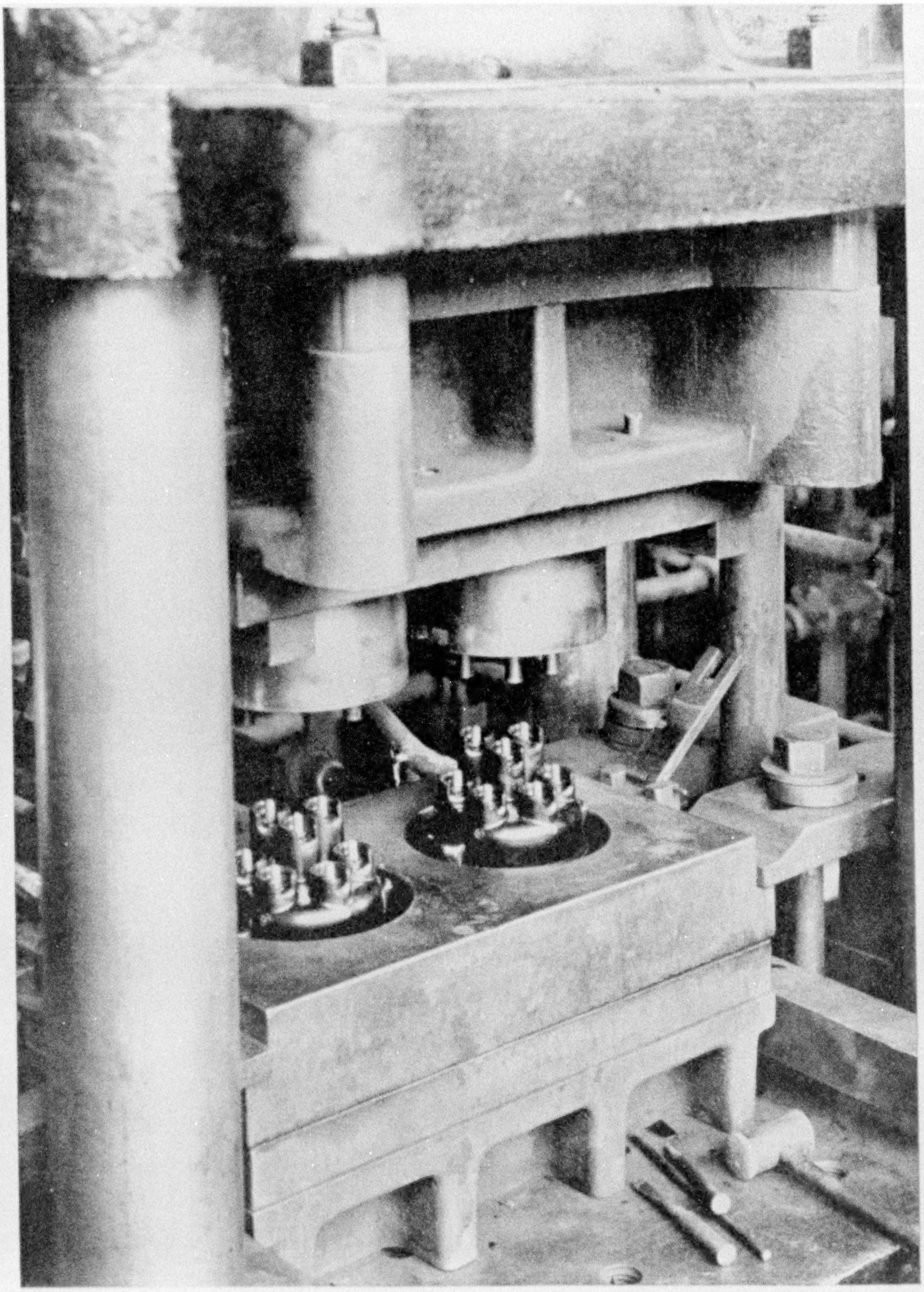
A questionnaire sent out to thousands of automobile owners at random all over the country throws some light on the specific increase in efficiency that the motor car brings to its possessor. The summing up of the answers shows a 56.7 per cent increase in working capacity. Applied to the millions of car-owners, this would represent the equivalent of adding nearly seven million new workers to the nation's productive forces.

The promotion of efficiency in those who own cars is only the beginning of the direct returns that the industry makes in balancing the tremendous expenditure for automobile transportation. It gives direct employment to more than a million men and indirect to two or three



GRINDING THE CYLINDERS OF A STANDARD "SIX" ENGINE

Each cylinder in a high-grade engine must be ground exactly true, both as to size and direction. It must not depart more than one ten-thousandth of an inch from standard size. Note the emery wheel in the fourth cylinder from the left. In a six-cylinder car, each piston makes 6,000 trips through its cylinder for every mile traveled (see text, page 366).



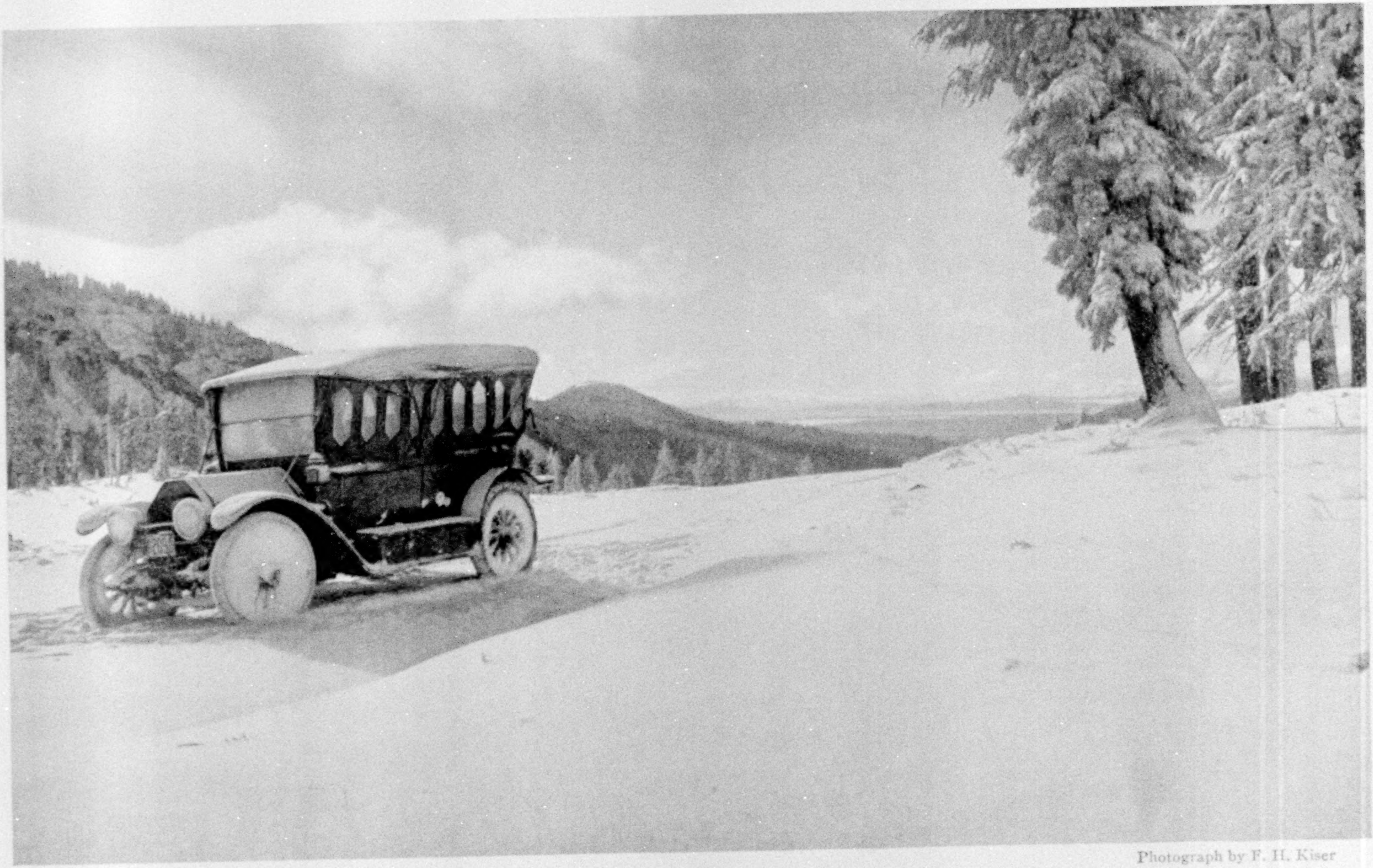
A PRESS FOR MOLDING BAKELITE DISTRIBUTER HEADS AND OTHER IGNITION PARTS

Bakelite is made by treating carbolic acid with formaldehyde, and comes to the automobile accessory manufacturer in a powdered form. He imbeds his terminals and other metal parts therein, and subjects it to high heat and heavy pressure, getting the fine, indestructible insulation required for his electrical parts, which do so much to reduce ignition difficulties.

Photograph from The Robbs

BESIDE A MOUNTAIN OF ICE CAST UPON THE SHORE OF GREEN BAY, NEAR ESCANABA, MICHIGAN

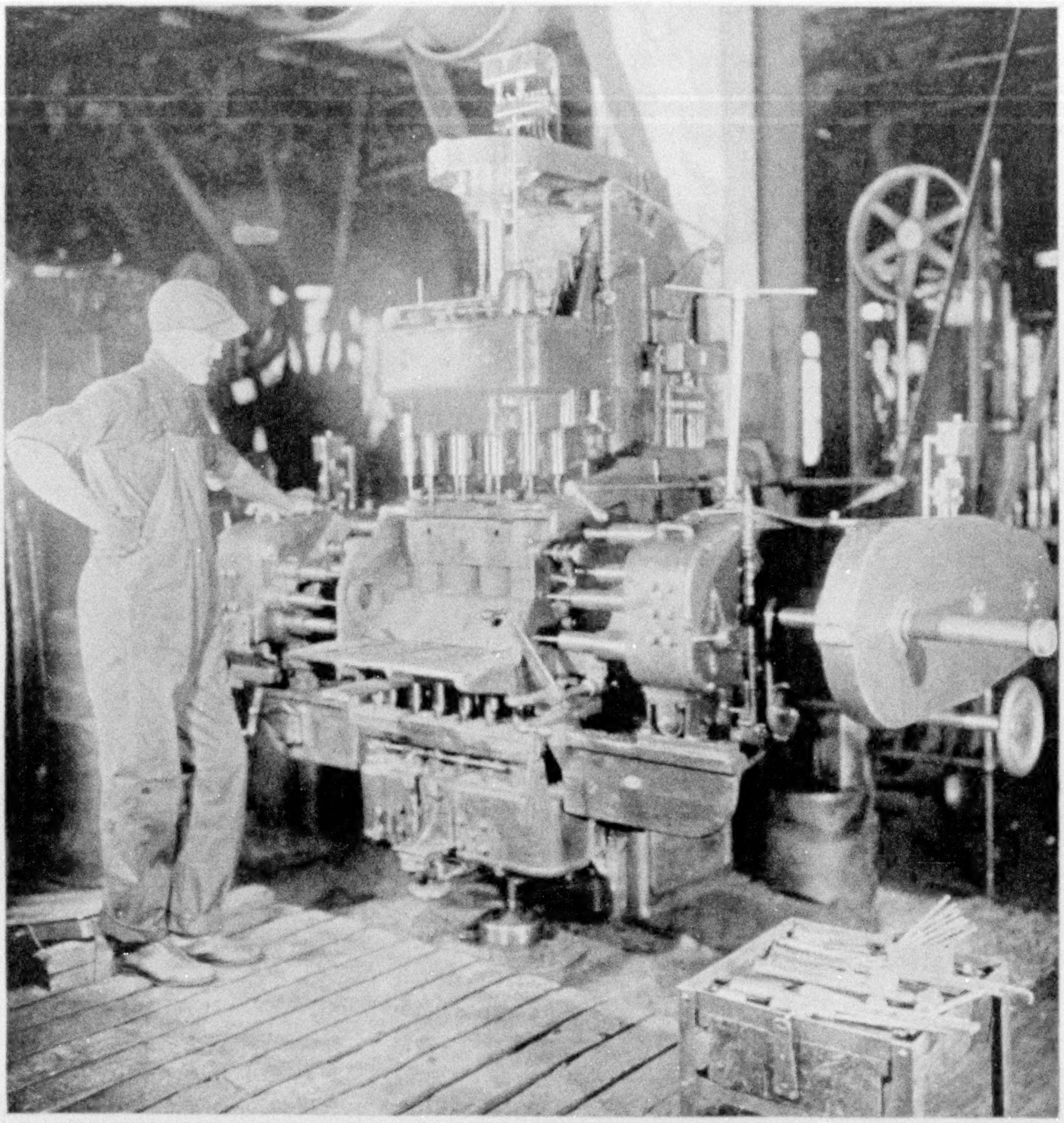
Ninety per cent of the public buy their cars from 20 per cent of the manufacturers. The other 80 per cent of the manufacturers divide the remaining 10 per cent of the sales among them. But catering to the 10 per cent who want something different means a trade worth more than half a billion dollars a year.



Photograph by F. H. Kiser

CAUGHT IN A SNOWSTORM ON THE RIM OF CRATER LAKE, OREGON

The cost of parts replacements in motor cars of the present day is surprisingly low, in spite of the high cost of installation. One major manufacturer shows that all parts sales for the year amounted to only $13 per car. This is wholesale, of course.



A BIG ENGINE-BLOCK BORING MACHINE IN OPERATION

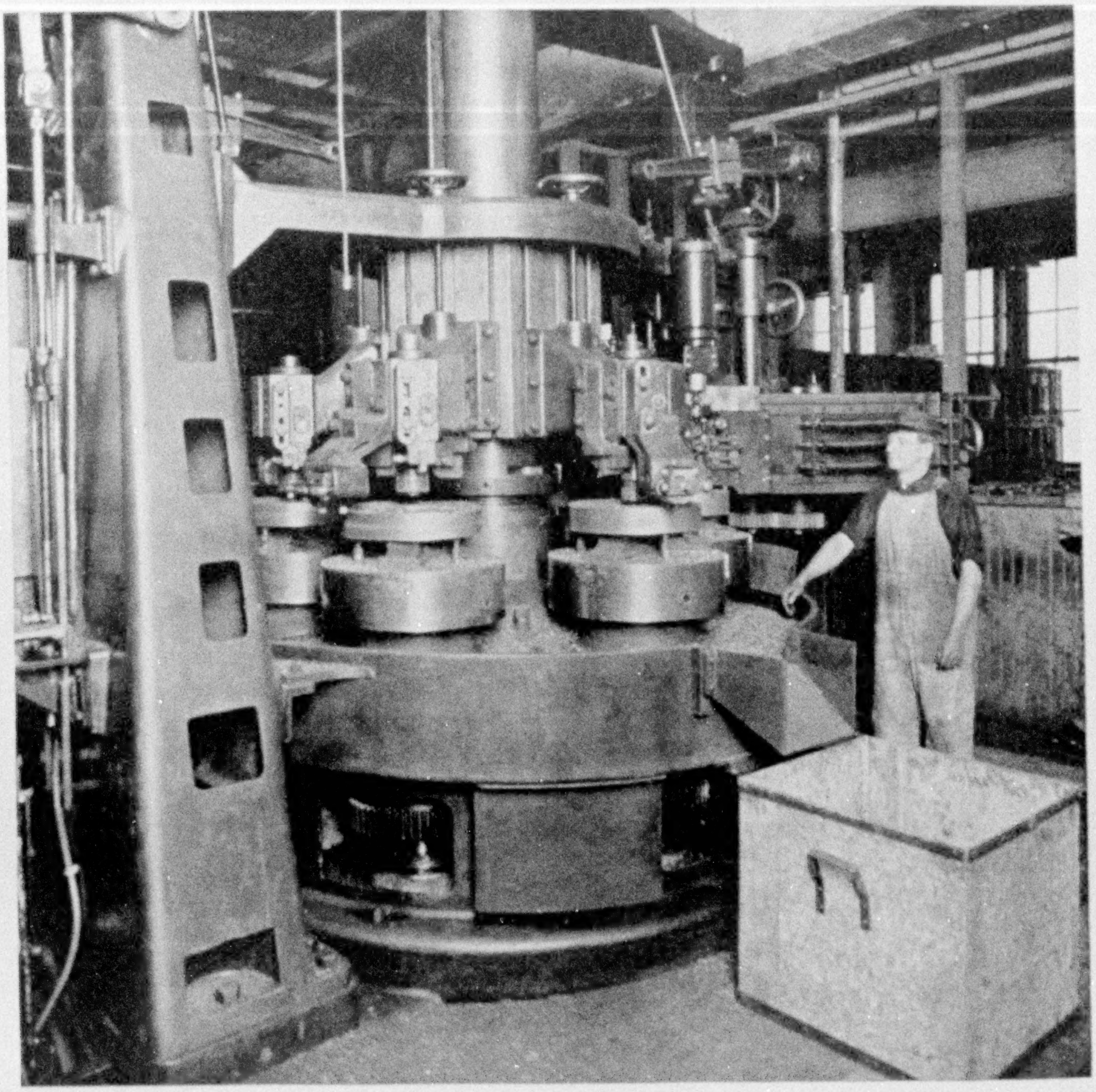
Boring some fifty holes, of various sizes and in four directions, at a single operation is typical of the methods of automobile manufacturers in reducing the cost of building cars by the elimination of unnecessary hand labor.

times as many. It buys the major portion of the country's plate glass, a vast share of its iron and steel, most of its aluminum, much of its leather. It gives the railroads much more freight to haul than it takes from them.

It has sent hundreds of thousands of people into the suburbs, where rents are cheaper and living conditions better, and where the savings in rent offset the car's maintenance costs, leaving the better living conditions as dividends.

Yet the direct contributions to national prosperity are small compared with the indirect contributions briefly referred to above—the expanding city and the narrowing countryside. What stories the rusty little cars parked around the rural high school could tell of boys and girls who will finish their secondary education, when their parents never got beyond the sixth grade!

Before the coming of the motor car, the farmer who was not up at five in the morning or who had left the field before sundown in the evening was accounted a shiftless tiller of the soil. From seven to seven in the field, with his morning



MACHINING FLYWHEELS

This machine has a whole battery of cutting apparatus which dresses up half a dozen flywheels at a time.

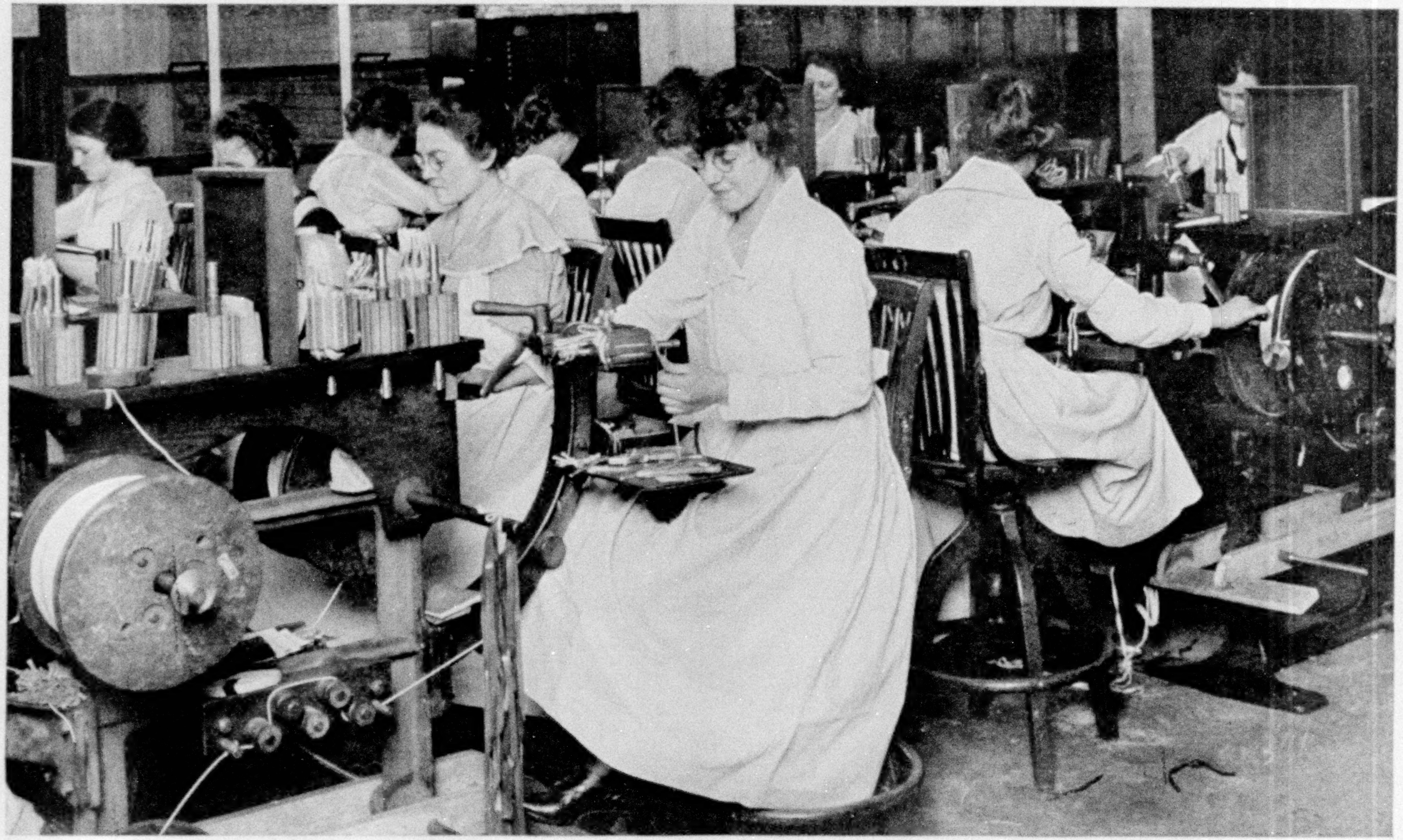
and evening chores before and after, was his routine.

HOME OWNERSHIP INCREASES WITH CAR REGISTRATION

That he is now released from such a grind; that his family is coming into its normal share of diversion and recreation; that he can provide his children with opportunities that fate hitherto denied him, is due mainly to the motor car and the train of advantages it has brought him. The farm bureau, the rural woman's club, the parent-teacher association, are but a few evidences of his intellectual emancipation. In Pennsylvania 65 per cent of the farmers own motor cars, and other States show similar percentages.

When will the point of saturation be reached, in the light of such direct and indirect returns, and in view of the fact that fewer deferred-payment buyers default on their cars than on household furniture; that definite statistics show home ownership increasing with motor-car registration; that national income increases as automotive transportation outgo swells?

Measured by California's present ratio of car-owners to population, it will not be reached until the present registration of the country is doubled.



WINDING ARMATURES FOR MOTOR-CAR GENERATORS

Until recently it has been necessary to wind armatures with these comparatively simple hand machines. To keep the tension uniform with the constant starting and stopping of the wire reels of the type shown in the left foreground was apparently an unsolvable problem. A new machine has just been perfected, however, which automatically winds the armatures, one girl being able to do the work of four, with none of the strain involved. The wire is drawn on a 15-pound tension.

Yet even California has not settled down to replacements. Measured by Indiana's existing ratio, the ultimate registration of the country would reach eighteen millions, but Indiana still shows herself far on the sunny side of saturation.

Those whose past predictions have been most nearly justified by the trend of events are making new predictions to-day, and these are that the point of saturation will not be economic, but rather physical. The congestion in the big cities is fast growing so great as to keep thousands of motorists out of the down-town districts.

BIG CITY TRAFFIC PROBLEMS

With all the traffic officers and signal systems, the task of handling the ever-flowing stream of motor cars and trucks grows apace. Some 42,000 motor vehicles pass the crossing at Fifth Avenue and Forty-second Street in New York every twenty-four hours; 4,500 in a single busy hour is not an unusual occurrence.

The block-signal system on Fifth Avenue, with traffic moving in a series of stops and starts, controlled from a central tower, has accomplished much, but even it is destined to prove inadequate. Boulevard traffic regulation, based on the Fifth Avenue practice, has also helped in many cities, but here again inadequacy is only a few years away.

Propositions are now coming from the foremost authorities for the establishment of express streets, where cars will move at rates of from forty to fifty miles an hour, and where gates will be established at intersections, just as at railway crossings. Commissioner Harriss, of New York, says that New York needs three north-and-south highways of this character, with traffic moving on each of them in three parallel lines in both directions. These streets, he says, will have to be four hundred feet wide and elevated in special instances.

Chicago is installing a synchronized traffic-control system similar to that now in operation in New York. This system of towers will extend south on Michigan Boulevard from Randolph Street, with the master tower at Jackson.

So great is the congestion in the famous Loop District in Chicago that proposals are being made to take all pedestrians off of the street level and to provide second-story sidewalks for them. The streets could then be widened to the building lines, almost doubling their present curb-to-curb width, and the sidewalks would be reached by stairways, ramps, and elevators. Vehicular and pedestrian traffic, each out of the way of the other, could move twice as fast as now and many times more safely.

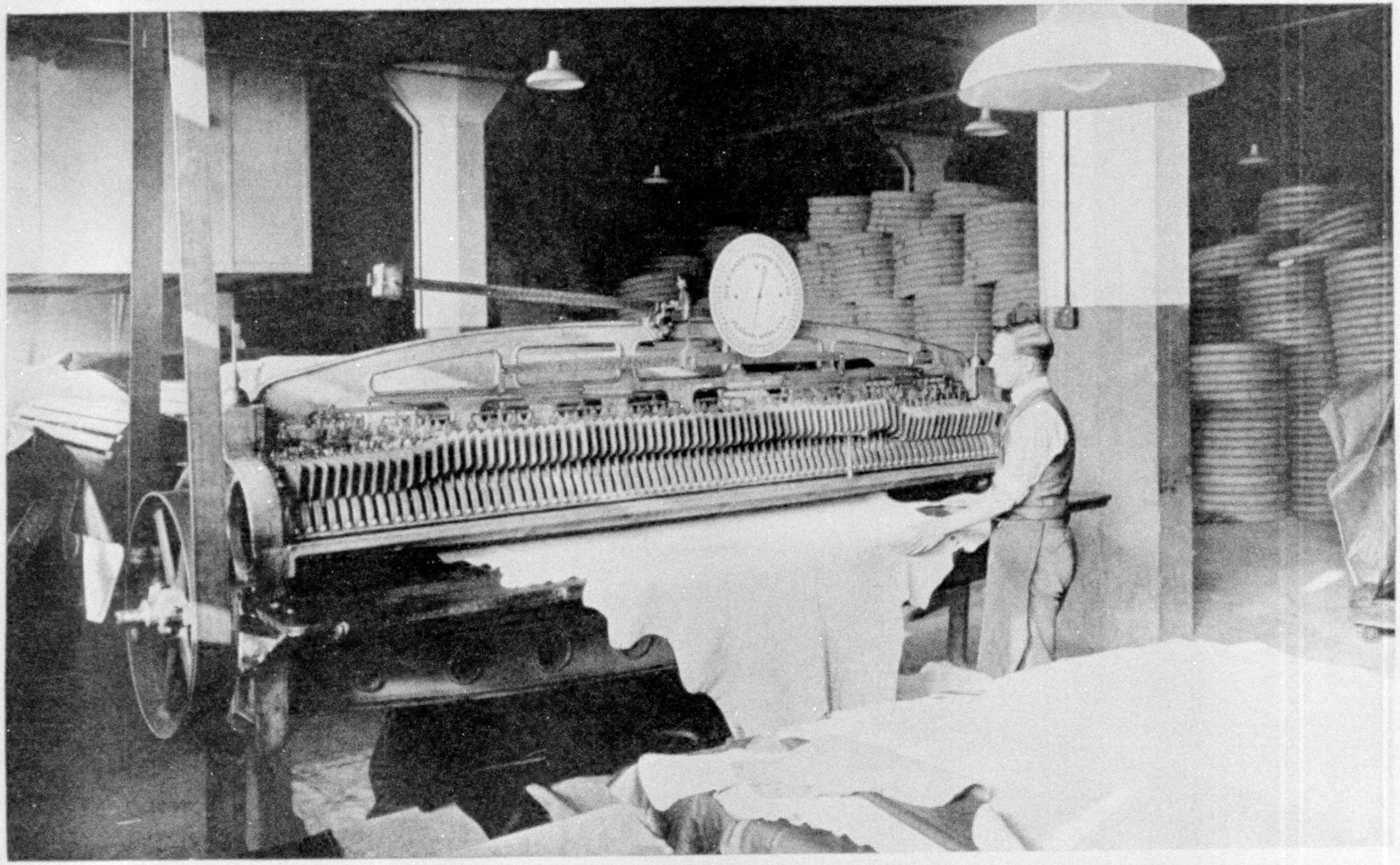
It is pointed out that such a plan would give two display window stories instead of one, and that the thousands of people who now avoid the Loop District because of its congestion would come back to trade there, their reclaimed business being large enough to more than compensate the property owners for the cost of the change.

The day may not be so far in the distance when the horse-drawn vehicle will be legislated off the crowded city thoroughfares, to lessen congestion, just as heavy traffic has been banished from the boulevards to protect the motoring public. Likewise, the day will inevitably come when truck traffic will be separated from passenger-car traffic on the busier highways through the countryside, just as is now the case on the fine Roosevelt Boulevard out of Philadelphia.

But whenever the point of saturation is reached, and by whatever route, it will not come before all manufacturing facilities available to-day will be kept busy making replacements. The average life of a motor car is six years. If 18,000,000 cars shall prove the limit, replacement requirements will call for three millions a year, which represent the present annual production.

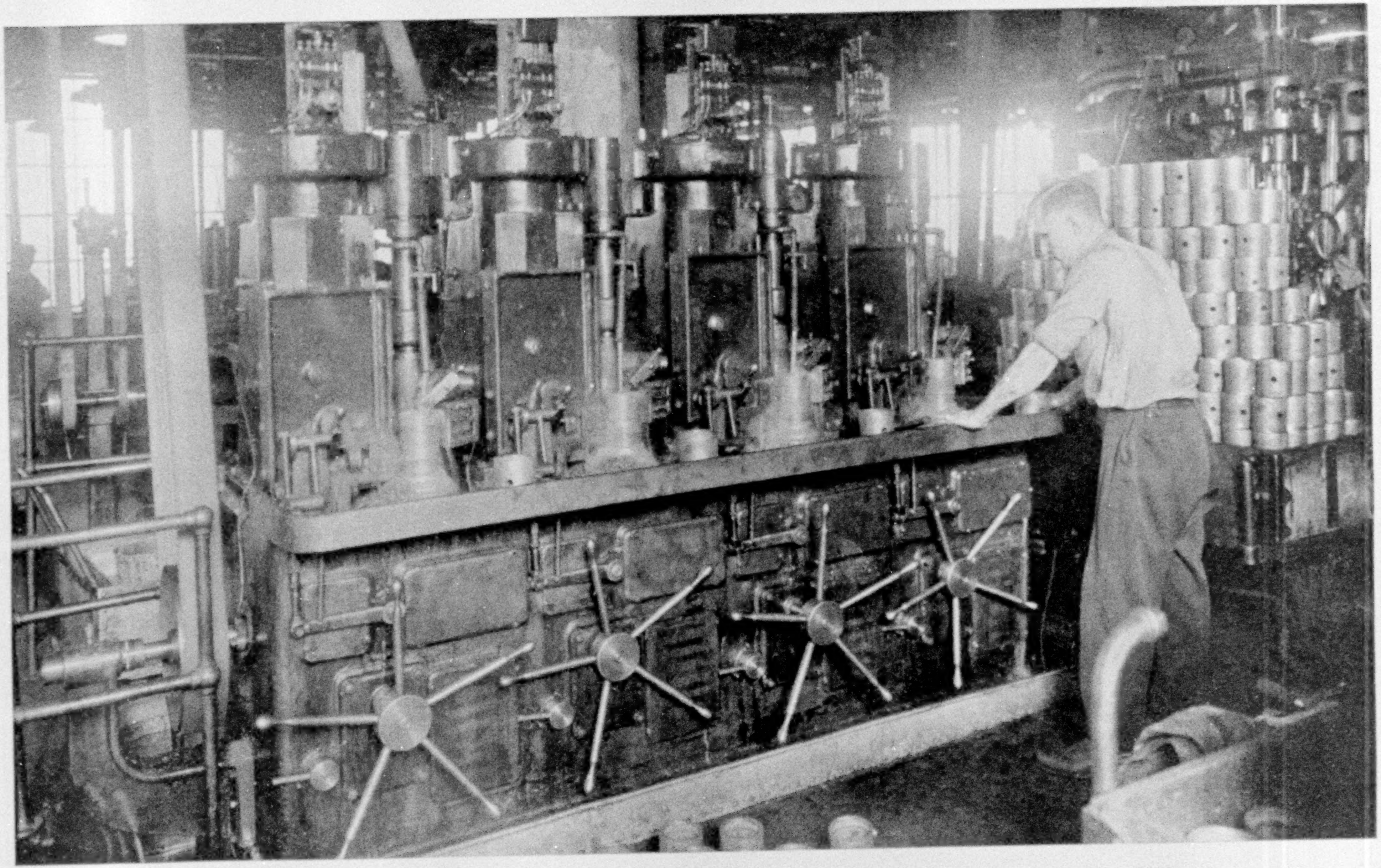
THE AUTOMOBILE AN EFFICIENT MECHANISM

There is little wonder that the automobile has caught the imagination of the American people. A race of individualists, the sense of power to go where they will, in their own way, has a deep appeal. Further than that, a mechanically minded people, they find a thrill in the possession of a mechanism whose purring motor bowls them along the highways at a pace that exhilarates and brings a change of scene every minute. They have a sort of subconscious reverence for its mechanical merit.



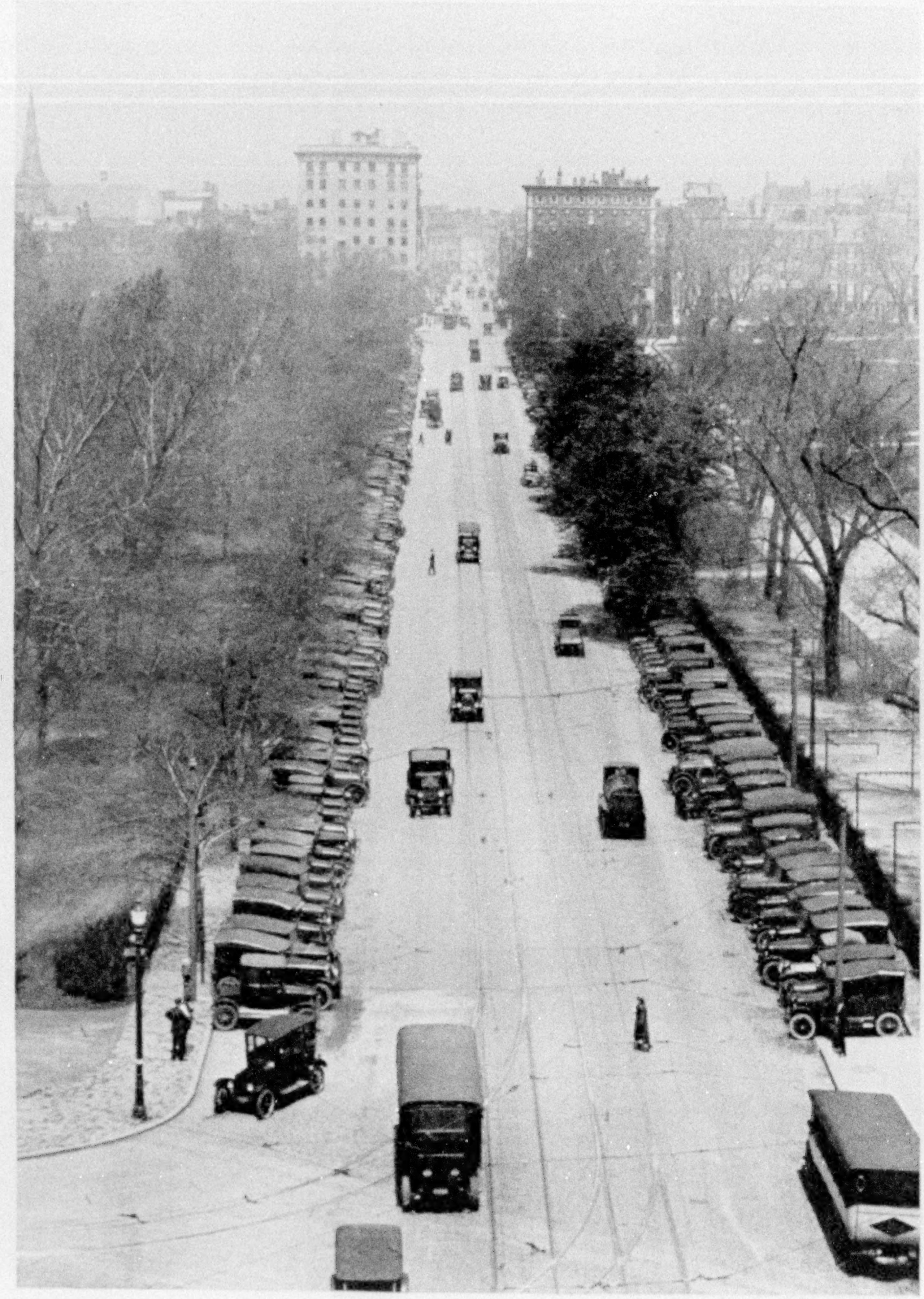
AN AUTOMATIC HIDE-MEASURING MACHINE

This mechanism is able to compute instantly the square footage of a hide with all its irregularities. As the hide passes through, every square inch is automatically noted and the total registered on the dial in front of the operator.



A MACHINE THAT FINISHES FOUR PISTONS ON THE TOP AND SIDE WALLS SIMULTANEOUSLY

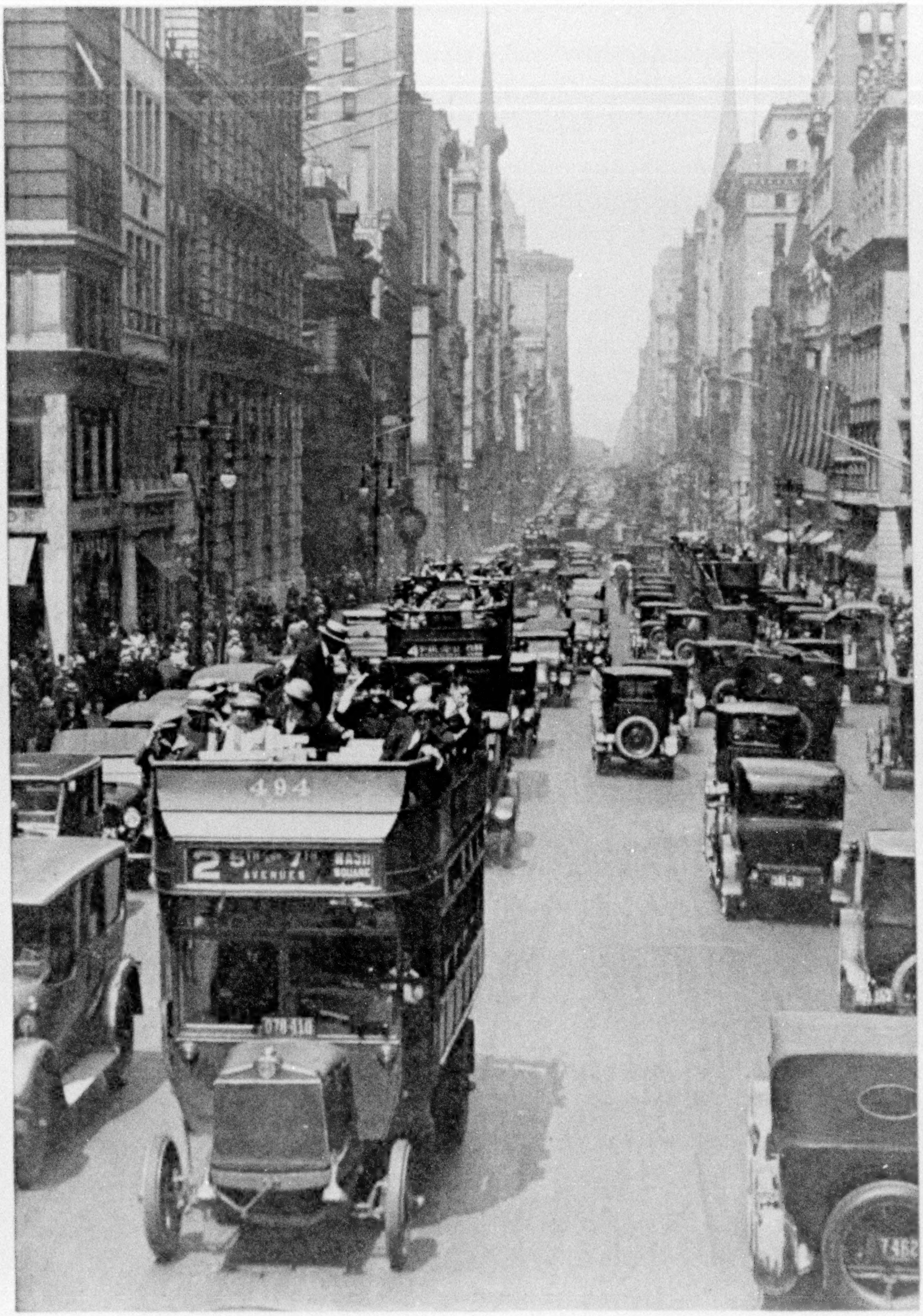
George Baldwin Selden, of Selden patent fame, probably lost untold millions by a simple little diary entry. His patent was applied for nearly two decades before the building of the first successful American automobile, but was not issued until years after. When he saw what is now the accepted type of four-cycle motor, he wrote, "Another of those d——d Dutch engines." On that entry the courts held he was not thinking of such an engine when he patented his vehicle, and therefore that the building of the modern motor car did not infringe his patent, although it was valid for other types of engines.



© Underwood & Underwood

A VIEW OF CHARLES STREET, BOSTON, WITH THE COMMON ON THE RIGHT AND THE PUBLIC GARDEN ON THE LEFT

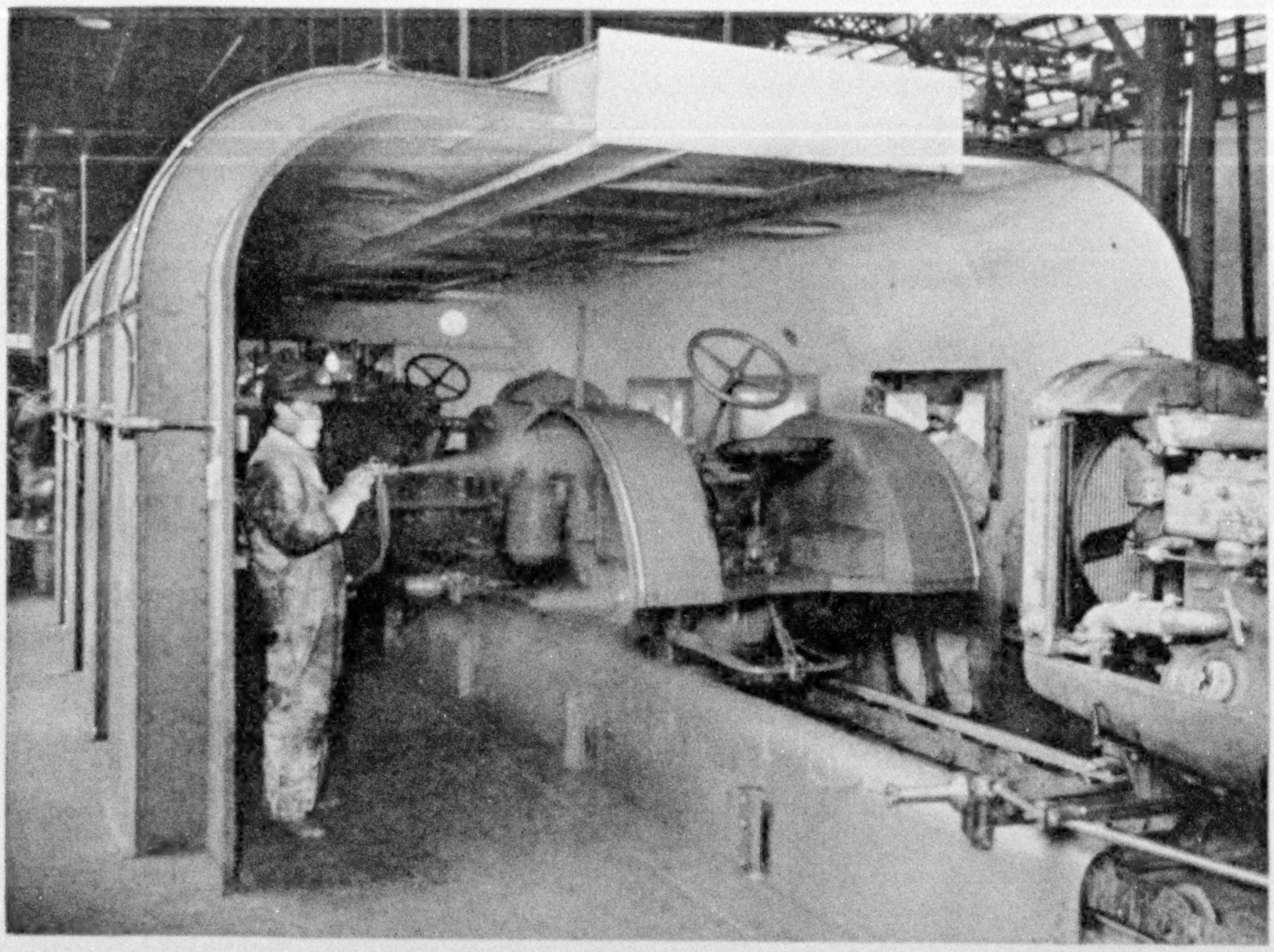
The passing of the day of putting down the tops of touring cars is to be noted wherever cars are parked.


494
2 5th and 7th AVENUES WASH SQUARE

© Ewing Galloway

MOTOR TRAFFIC ON FIFTH AVENUE, NORTH OF 42ND STREET, NEW YORK: A NORMAL SCENE AT ANY HOUR OF THE BUSINESS DAY

"Some 42,000 motor vehicles pass the crossing at Fifth Avenue and 42nd Street every twenty-four hours; 4,500 in a single busy hour is not an unusual occurrence" (see text, page 361).



PAINTING WITH COMPRESSED AIR IN A TRACTOR PLANT

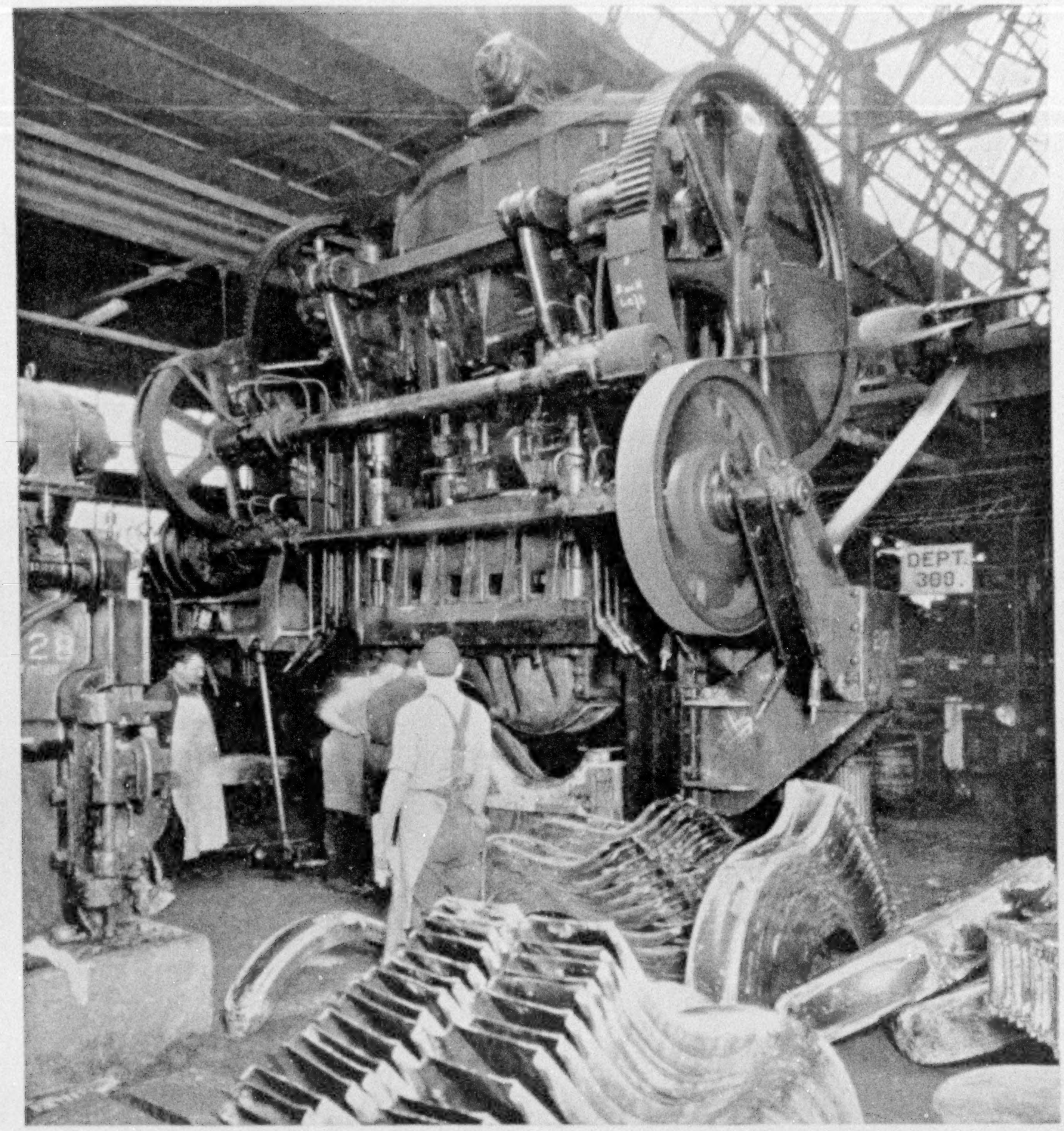
By the time the tractor reaches this booth on the assembly line, everything is in place except the wheels, which are put on just beyond the paint booth. Gray paint is sprayed on by compressed air. After the wheels are put on, the line passes through a drying tunnel 110 feet long, in which the temperature is maintained at 150 degrees.

And well they may! Consider what a present-day model automobile is. Its engine might be likened to a Gatling gun capable of propelling itself a mile a minute and, if it be a "six," of firing nine thousand shots a minute in doing so, without noise, undue heat, or disturbing wear, but rather with a smooth hum or a peaceful purr that is music to the ear of the motorist. A "four," even at twenty miles per hour, fires two thousand shots a minute.

The crankshaft must do three thousand full turns in the average car to carry it a mile, and each piston must make six thousand trips through its cylinder, with a stop between each of them, in making that mile. At sixty miles you ask each valve to open, admit the live, or discharge the dead gas, and close again, in 1/200 of a second. And they are expected to do it with clockwork regularity.

The car also brings to its owner an individual light-and-power plant with which he may start his car and light his path. It gives him a clutch that lets him make or break the power between his engine and his car at will and in a twinkling; a gearshift that lets him choose between power and speed and makes the change in a moment; brakes that give him complete control of a ton and a half vehicle with a slight pressure of the foot or a light pull of the hand. It furnishes him with tires made of a rubber composition nearly three times as durable as leather and fully three times as resistant to a sand blast as iron.

Compared with any previous instrument of transportation, the automobile is a wonderful device. A railroad engine, made to run over the smoothest roadbed in the world and with comparatively slow-moving parts, must be overhauled at the end of every run. On the other hand, given gas and oil, grease and water, in proper quantities, the "trusty old bus" will hum along for two hundred miles a day,



A STAMPING PRESS THAT COMPLETES FIVE FENDERS A MINUTE

This great machine turns out 2,700 fenders per day, one fender at each stroke. So accurate is the operation that the fender requires no further finishing touches, but is ready to be enameled as soon as the pressure of 225 tons is removed.

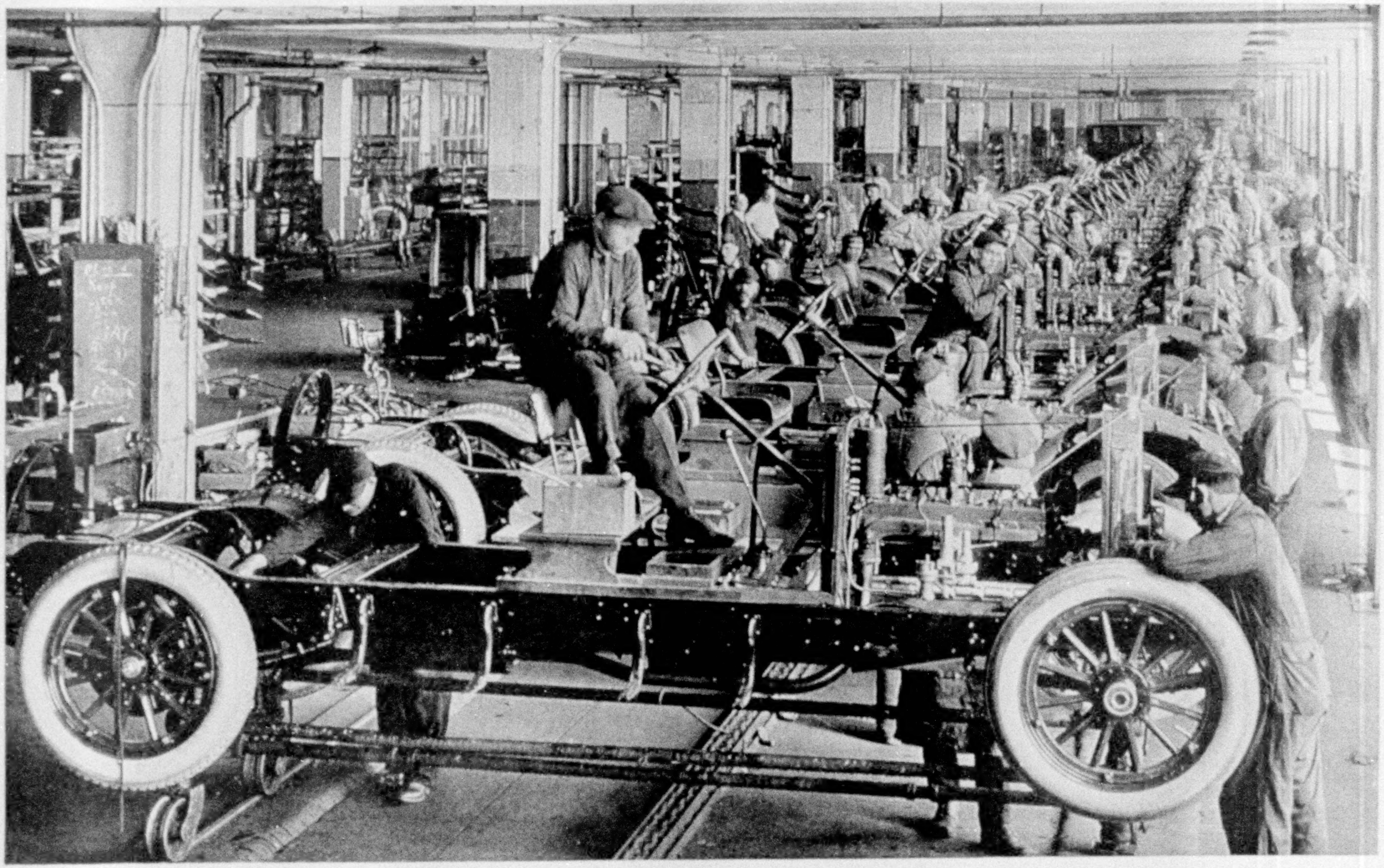
willing to give you, if it is a "six," more than half a million flywheel revolutions, nearly two million sparks, and more than seven million piston stops and starts, and be ready to repeat the performance on the morrow and many other morrows.

PROBLEMS THAT REMAIN TO BE SOLVED

Yet, far as our automotive engineers have gone in making a dependable, foolproof, vibration-defying, long-lasting motor car, they realize that much distance remains yet to be traveled before the goal of excellence they are striving for can be reached.

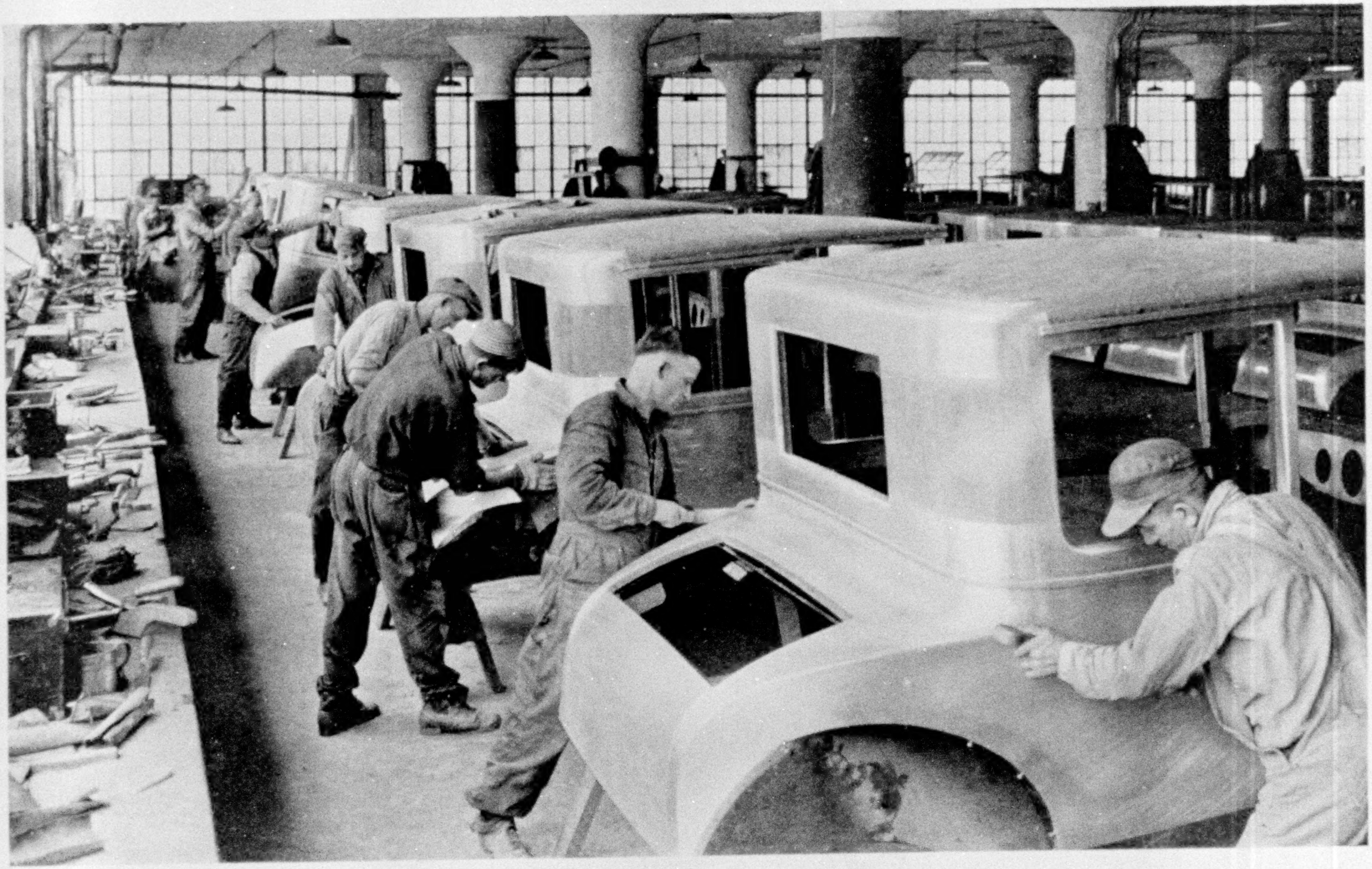
To begin with, our engines to-day deliver us only ten cents' worth of power for every dollar's worth of gas they burn. Their pistons must travel twenty inches, on the basis of one explosion to every four strokes, to deliver five inches of push to their load.

Likewise, our cars ask us to move from 400 to 5,000 pounds of dead weight per person carried, depending on whether they be loaded "flivvers" or big sedans



THE FINAL ASSEMBLY LINE IN A BIG AUTOMOBILE FACTORY

When cars were first built, all the parts were simply dumped in piles on the floor. Now a frame starts down one line, an engine block down another, a transmission and rear axle down others. When they all meet, they have each been assembled and are ready to be united into a completed chassis on the final assembly line.



FINISHING THE METAL WORK ON THE BODIES OF A QUALITY MAKE OF CAR

Such bodies as these require about a hundred days from raw material to finished product. The new steel, baked-enameled bodies go through the factory in less than two days (see text, page 373).

XUM

FACTORY TESTING OF SPEEDOMETERS

Before being packed, speedometers are given a final test for accuracy by running them at different speeds on a testing machine. This is the last of the 557 inspections given each instrument and its parts in the course of its construction.

with only the owner inside. These and other items in the present car's make-up stand as a perpetual challenge to the automotive engineer, and he is addressing himself vigorously to the task of correcting them.

RUNNING DOWN THE "KNOCK"

When cars were first made, the builders simply bored holes in blocks, put pistons in them, and had engines. They had only a general idea of what happens when a spark is applied to a compressed charge of gas in an engine cylinder. When the explosion took place under high compression, there came a knock that seriously reduced the engine's efficiency. All sorts of explanations for this knock were offered.

Then Mr. C. F. Kettering and his associates of the General Motors Research Laboratories decided to look into cylinders and see what does actually happen when a spark ignites a charge of gas.

They built a glass engine, and through its walls were able to see what occurred. They found that in an explosion under high compression there is a secondary detonation whose energy waves move seventy times as fast as those of the primary explosion. It is the conflict of these two series of energy waves that makes the power-destroying "knock."

How to overcome this detonation became the next problem. The whole list of elements and compounds known to the laboratory was gone over and every one that offered any hope was tested. It was finally found that by adding tetra ethyl lead and a second compound in the proportion of about five thimblefuls to the gallon the secondary detonation was entirely avoided, and smooth running, even under the high compression beyond the control of a retarded spark, was made possible.

It has been found that the new combination makes five gallons of gasoline do the work of six, and the engineers assert that by reducing the size of the cylinder and the stroke of the piston it will be possible to produce higher-speed engines that will more than double the present mileage obtained from a gallon of gas.

On the other hand, there are engineers who say that while this will make possible the saving in gas, it will result in a corresponding wear on cylinder walls by the increased distance the pistons must travel to produce a mile of transportation.

The reduction of weight in cars is a very important item in the future plans of automobile design. One noted manufacturer says that unnecessary weight is as useless in a car as a cockade on a coachman's hat, if not more so, since the cockade at least serves the purpose of identification. The reduction of weight means smaller motors, lighter axles, and less cumbersome frames and running gear, all of which promise less expensive tires and decreasing operating costs.

OVERCOMING THE NECESSITY OF WATER-COOLING

One of the new departures in engine design that serves to reduce weight is the substitution of copper-cooling for water-cooling. The function of water in an automobile engine is to carry the heat from the cylinders to the radiator cells, where it is released by radiation.

For a long time, at least one manufacturer has been able to produce an air-cooled engine, with iron fins surrounding the cylinders, that has stood up well in every-day service. The engineering textbooks all declare that it is impossible to fuse copper and iron in a commercial way. However, at least two manufacturers have succeeded in doing so, and two cars are now on the market with copper cylinder jackets which claim to give radiation efficiency fully up to the standard of the modern water-cooled system.

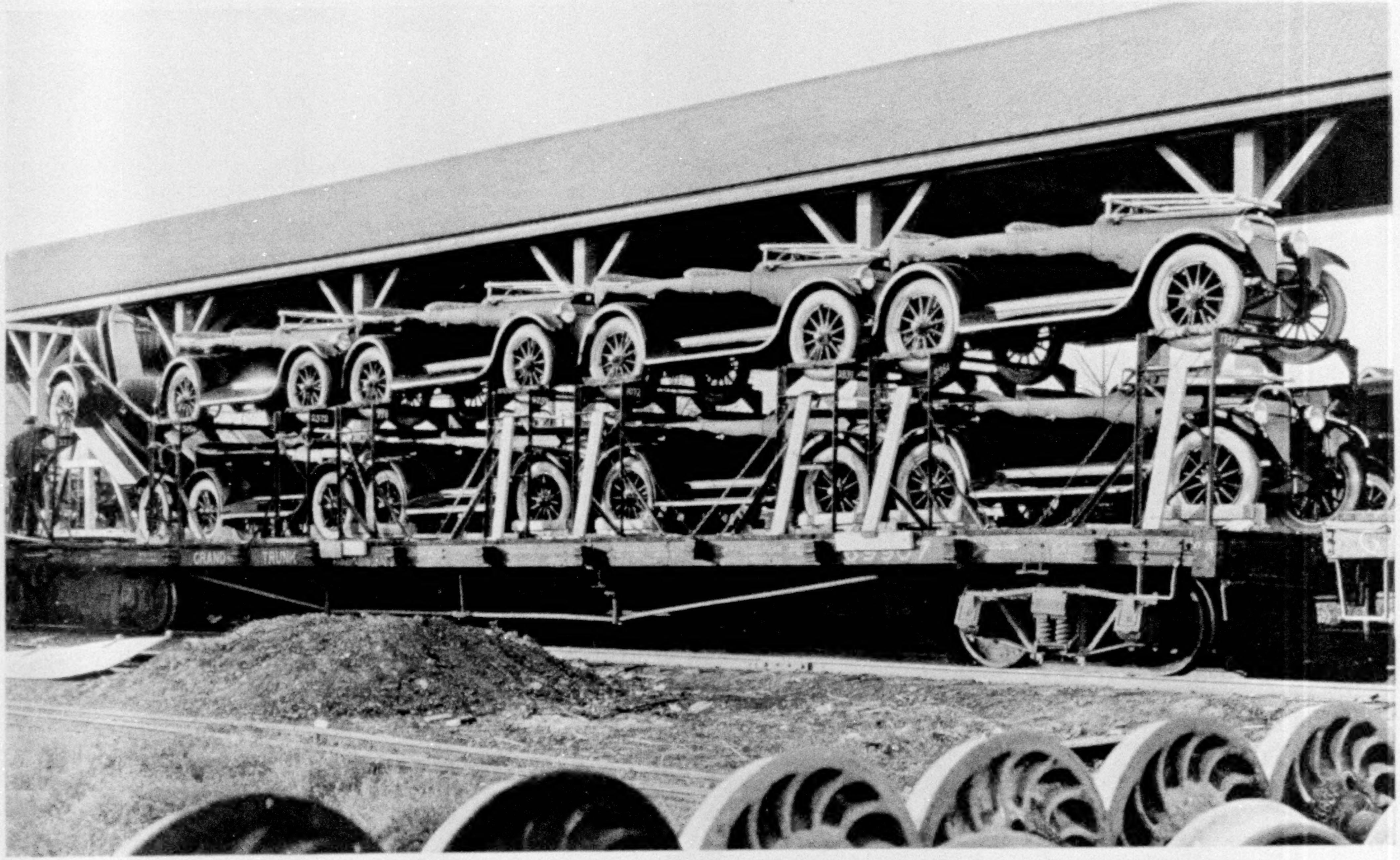
Copper, being much more efficient as a heat-radiating medium than iron, makes an ideal substitute for water, eliminating radiator repairs, freezing dangers, etc. The copper-cooled engine weighs less by about 130 pounds than a water-cooled engine of similar horsepower and cooling efficiency.

ANTI-FRICTION BEARINGS

One of the prime causes of short life in motor cars is neglect in the matter of lubrication. Owners of fleets of cars, notably some of the taxicab companies, get from 200,000 to 300,000 miles out of a machine. The owner of an individual car considers that he has done well when his odometer registers 50,000 miles. His neglect of lubrication is more frequently responsible than any other one item for his low mileage.

The General Motors Research Corporation has been working on the task of producing a nonfriction bearing, and demonstrations at Dayton point to complete success. Instead of melting the metal and molding the molten fluid, it is powdered, put into the mold in that form, and subjected to heat. The alloy has a lower melting point than the steel itself and thus is made a homogeneous part of the material. When taken out of the furnace, the bearing has a certain porosity not present in bearings molded in the orthodox manner. It is capable of absorbing a certain percentage of its weight in lubricants.

Under dynamometer tests these bearings have been run at 2,000 revolutions per minute, which is equivalent to a speed of the crankshaft of a car running 40 miles



DOUBLE-DECKING FLAT FREIGHT CARS FOR BIG MOTOR-CAR SHIPMENTS

Despite the fact that a third of a million carloads of cars were shipped from factories last year, and 75,000 more from assembling plants, and still other thousands by Great Lake steamers, it has been necessary to send many cars to distribution centers in drive-away fleets. One manufacturer maintains a corps of drive-away men, sending the cars out in fleets of ten, each with a captain and a mechanic. Drivers are not allowed to raise the hoods of their cars and must keep their assigned positions in the fleet. The speed is held down to 25 miles an hour.

an hour. Although told that they had been running for 3,600 and 3,700 hours without stop, they were still cool enough for me to bear my hand on them when I examined them.

With frictionless bearings, burned-out bushings will probably be a thing of the past. The antifriction element in them will be used mainly to counteract neglect. It will be the savings-account funds of car operation—not to be drawn on except in emergency.

THE STATUS OF STEEL BODIES

Engineers predict that the automobile bodies of the future in all quantity-production cars will be steel. Not only does metal construction reduce the time required for the completion of a sedan body from more than one hundred days to less than two, but it also makes a more lasting job.

Instead of glue and screws with which a wooden body is put together, electric welding and rivets are used, which make for permanency. It is the difference between the modern all-steel Pullman car and the old-fashioned coach of wood construction.

Baked-on enamel, applied in a few hours, if correctly put on, shows much more durability than the best hand-painting, which requires eighteen days or more. The enamel does not deteriorate, but, owing to atmospheric and temperature conditions, merely collects a residue of blue scum that is readily removed with a proper polish. A report of an enamel job done in 1914 was made at a recent meeting of a branch of the Society of Automotive Engineers. Good care had been taken of the car; it had been polished and kept clean, and in 1922 appeared practically as new.

MEETING THE DEMAND FOR ACCESSIBILITY

The motorist of the future will demand accessibility of parts. The important thing with taxicab companies is the keeping of their vehicles out of the shop and in the streets. Therefore, accessibility of parts is a sort of religion with the leading manufacturers of taxicabs.

Bolts and nuts must be so located as to insure ease and rapidity in removal or installation, and parts must be quickly exchangeable.

So thoroughly has the construction of a standard type of cab been simplified that twenty minutes is now the time allowed for the replacing of a spring, forty minutes for the removal of an engine, and fifty minutes for the reinstallation of an engine.

The introduction of the flat rate in service charges, whereby each operation is done at a factory-fixed rate, is destined to hasten the simplification of car design, for the manufacturer who can make a car simpler for the repair man than his competitor can give a lower rate for service, and this will be one of the standards by which the future buyer will determine who will make his next car.

A leading taxicab manufacturing company, with its vast fleet of cars in operation and its detailed cost-keeping system for car operation, is doing much to guide the industry toward the production of cars whose maintenance costs will be lower.

THE ADVANTAGES OF SUPER-SIZED TIRES

It has been found that vibration is the worst enemy of an automobile, and this evil has been attacked from many angles.

One line of investigation has been in the reduction of tire-inflation pressure. In pursuing this investigation it has been found that by the further extension of the oversized tire principle, inflation can be reduced from the sixty or eighty pounds pressure to thirty and forty pounds.

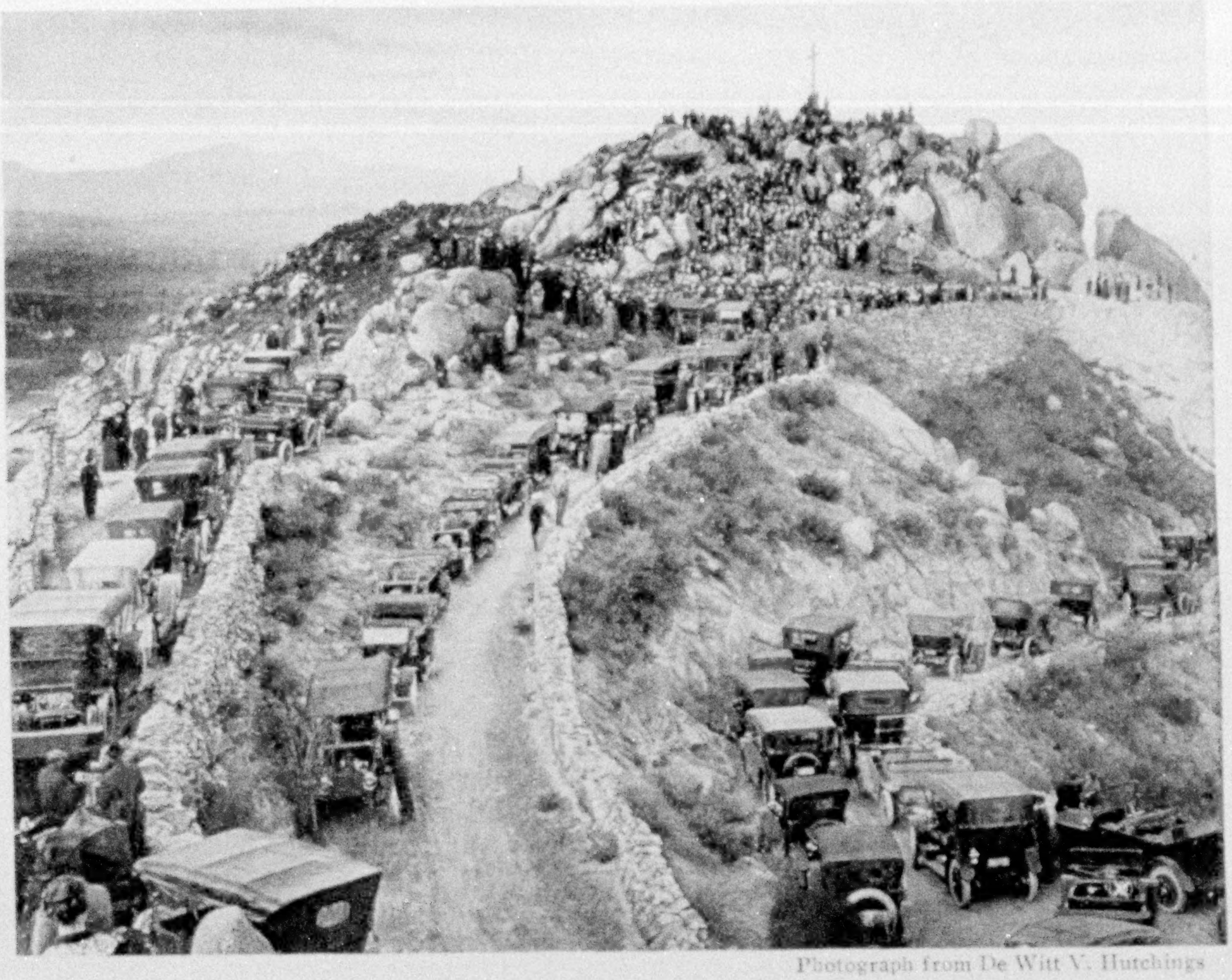
One taxicab company is having tires made with wider treads. This has been carried so far that some of the tires look like big, fat sausages. But the reduction of vibration due to their softness has shown amazing results in cost of car upkeep and even in car life. The tires are built with thinner walls, and through their ability to take the minor shocks of the road more easily, their mileage is lengthened to such a degree as to compensate for their higher cost, leaving both the car protection and ridability as dividends on the investment.

Skidding is reduced to a minimum with these super-sized tires, brake control is made more complete, and muddy roads are robbed of many of their terrors. Steering is not noticeably more difficult at ordinary speeds, though admittedly

Photograph from F. C. Doig

THE LAKE CRESCENT ROAD, AMONG THE FINE FIRS OF THE STATE OF WASHINGTON

A proposition is now being advocated to give the North Coast people a bridge entrance into San Francisco. A territory as large as the State of Rhode Island would thus be thrown open to settlement. It is proposed to charge a bridge toll of $1.18 per car and 15 cents per passenger or pedestrian. The bridge would be about 7,500 feet long. In 1921, 200,000 cars were handled on the Golden Gate ferry.



Photograph from De Witt V. Hutchings

ARRIVING BY MOTOR FOR THE RUBIDOUX EASTER SERVICE, RIVERSIDE, CALIFORNIA

it is somewhat harder at slow speeds, as is the turning of the front wheels when the car is standing still.

The coming of the super-sized tire will result in a smaller wheel—a wheel, indeed, not much larger than some of the brake drums now in use. It may mean a slight lengthening of the axles in order to maintain the present turning radius, though, on the other hand, it may be decided to concede a little in turning radius in order to maintain the present axle-length.

FOUR-WHEEL BRAKES A NEW DEPARTURE

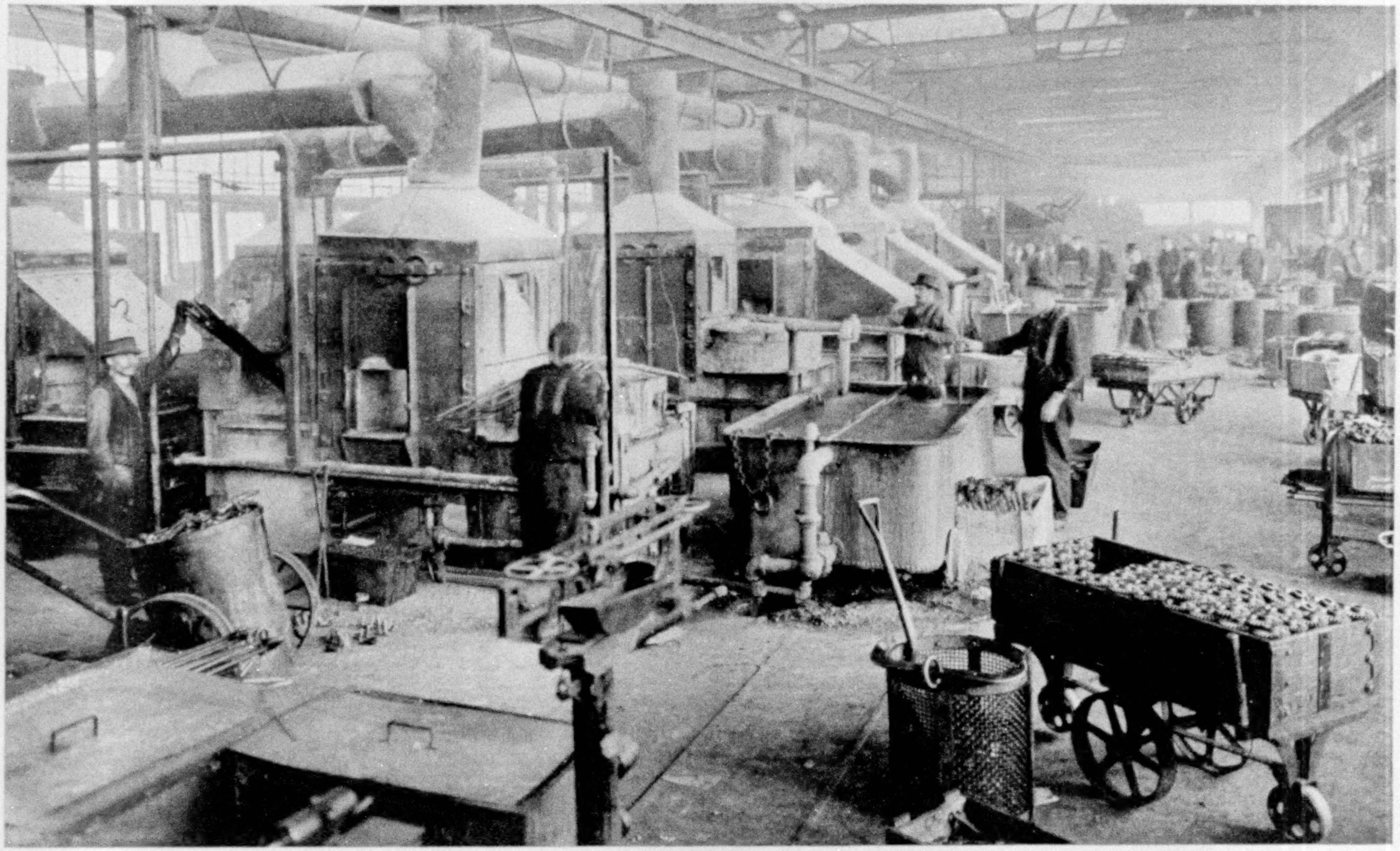
With the increasing use of automobiles increased control of the individual car is demanded. To be able to bring a car more quickly to a standstill sometimes means the avoidance of an accident. Four-wheel brakes are beginning to make their appearance in this country, and have been found to cut practically in half the distance required for bringing a moving car to a stop. Many manufacturers believe, however, that the super-sized tires will give the requisite braking efficiency without resorting to four-wheel brakes.

WHO SETS THE FASHIONS IN MOTOR-CAR DESIGN?

Automotive engineers are giving more and more attention to what they call the passenger accommodations — everything above the chassis. While the body and its accessories have little to do with the mechanical merit of the car, they have a vast deal to do with the sale demand.

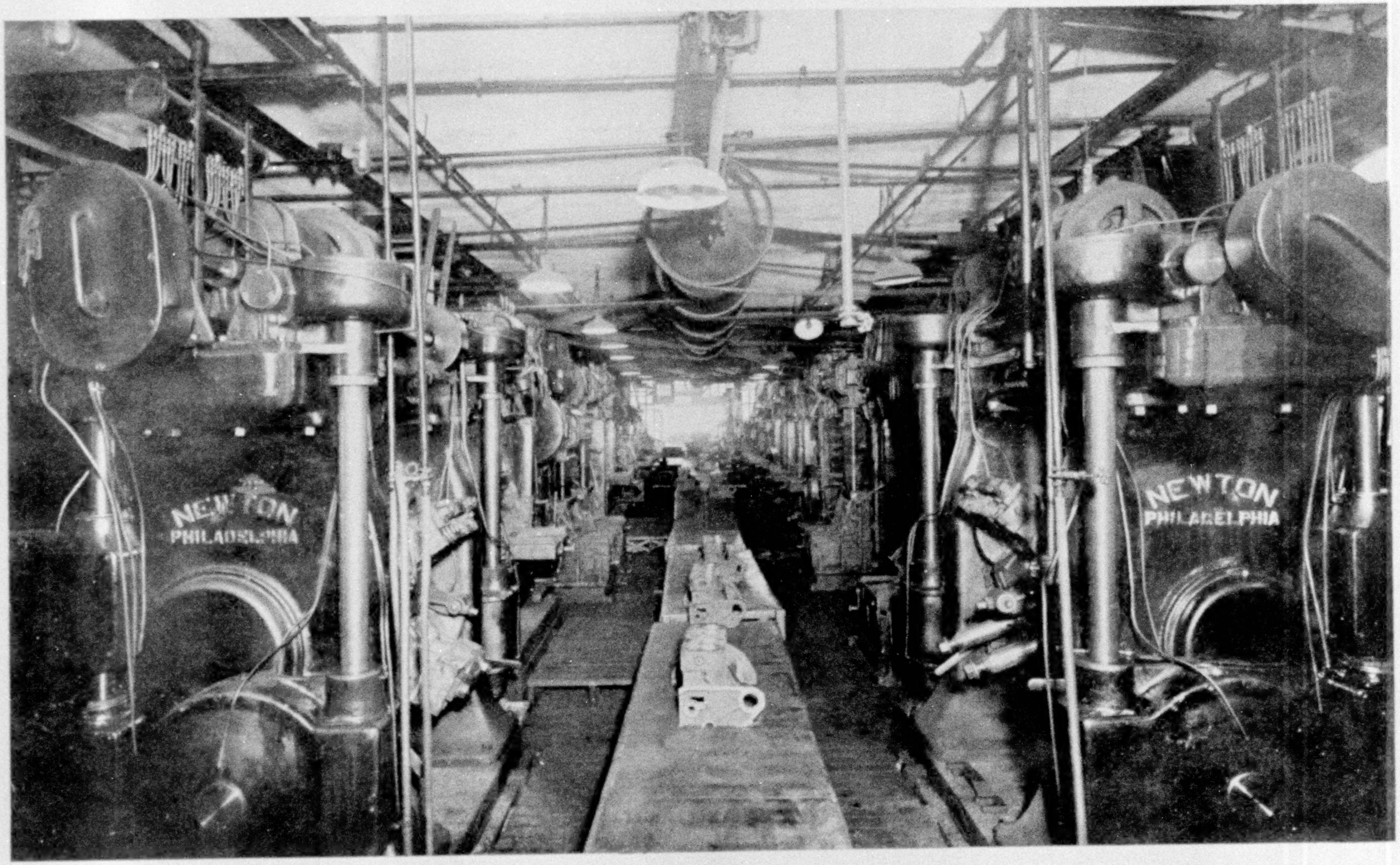
And this, in turn, throws some light on the question of who sets motordom's fashions. A manufacturer making an assembled car on a small scale brings out something new in body design—say, a new sport model. It has various little touches that please the eye and promote the comfort of the passenger.

When it goes before the public, many buyers forget the fact that the value of a motor car is mainly in the chassis, and make a selection without considering that phase of the subject.



THE CYANIDE OF POTASSIUM FURNACES IN A DETROIT MOTOR-CAR PLANT

Heat-treating and case-hardening have done a vast deal toward making the automobile stand the strains to which every-day usage puts it. This one plant uses enough cyanide every day to destroy the entire population of the New World (see text, page 400).



ONE OF THE REASONS WHY PEOPLE OF MODERATE MEANS CAN AFFORD GOOD CARS

In the elimination of lost motion, automobile manufacturers are ever on the watch for improvements. In the machining of engine blocks older installations take one block at a time, put it on a bed and move the cutting tool back and forth over it, with each backward movement an idle one. The machine here takes a half dozen blocks and rotates them past the cutting tool, eliminating the idling back motion. Reduced cost of milling engine blocks is the result.

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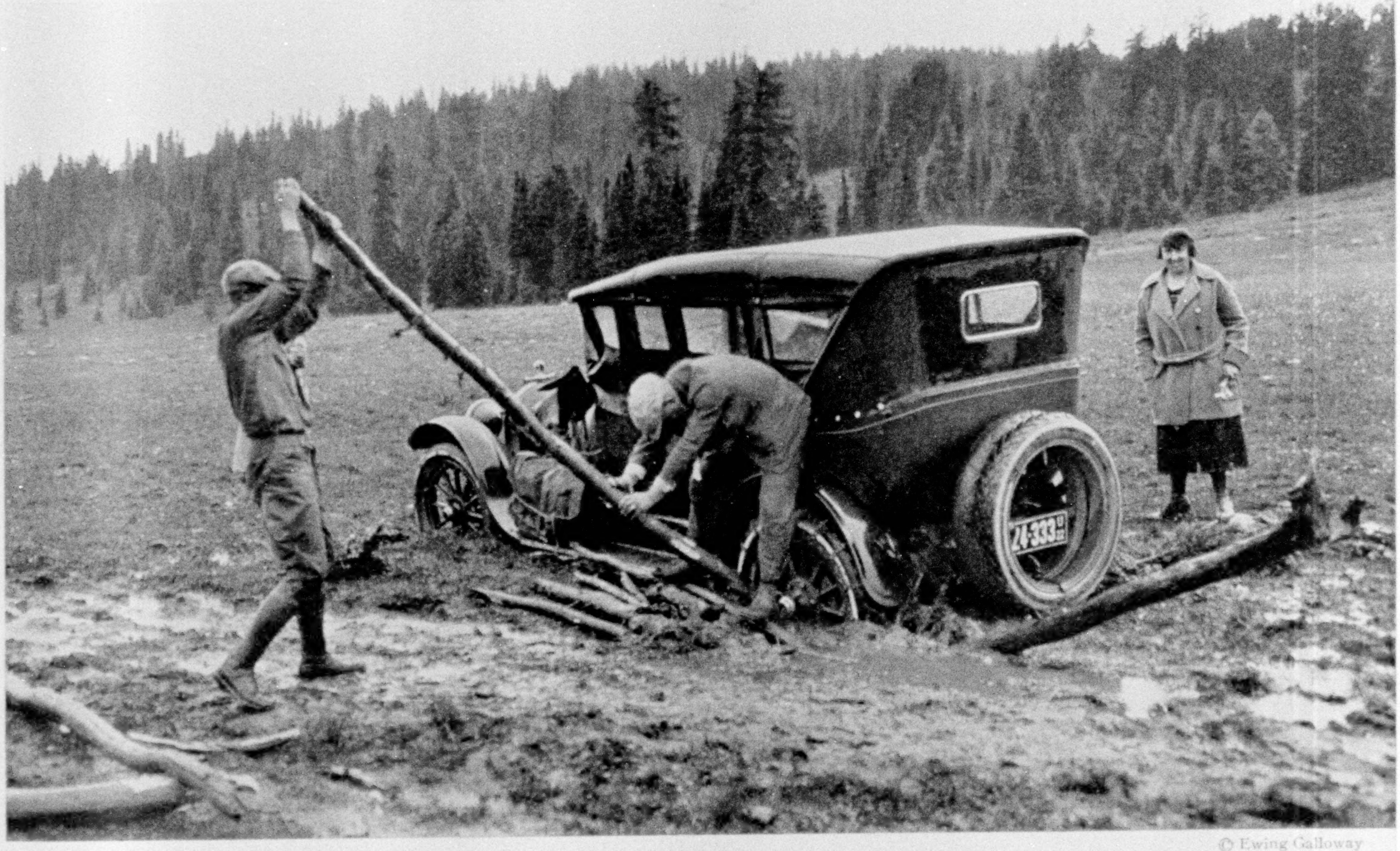
HANGING ON BEHIND: THROUGH A FORD IN ROCK CREEK PARK, WASHINGTON, D. C.

A Michigan lumberman invented the modern spark plug; a Russian Jew, the demountable rim; a mid-western engineer, the orthodox self-starter; and a New England Yankee, the antiskid chain—a quartet of inventions that has been a major factor in the development of motoring in America.

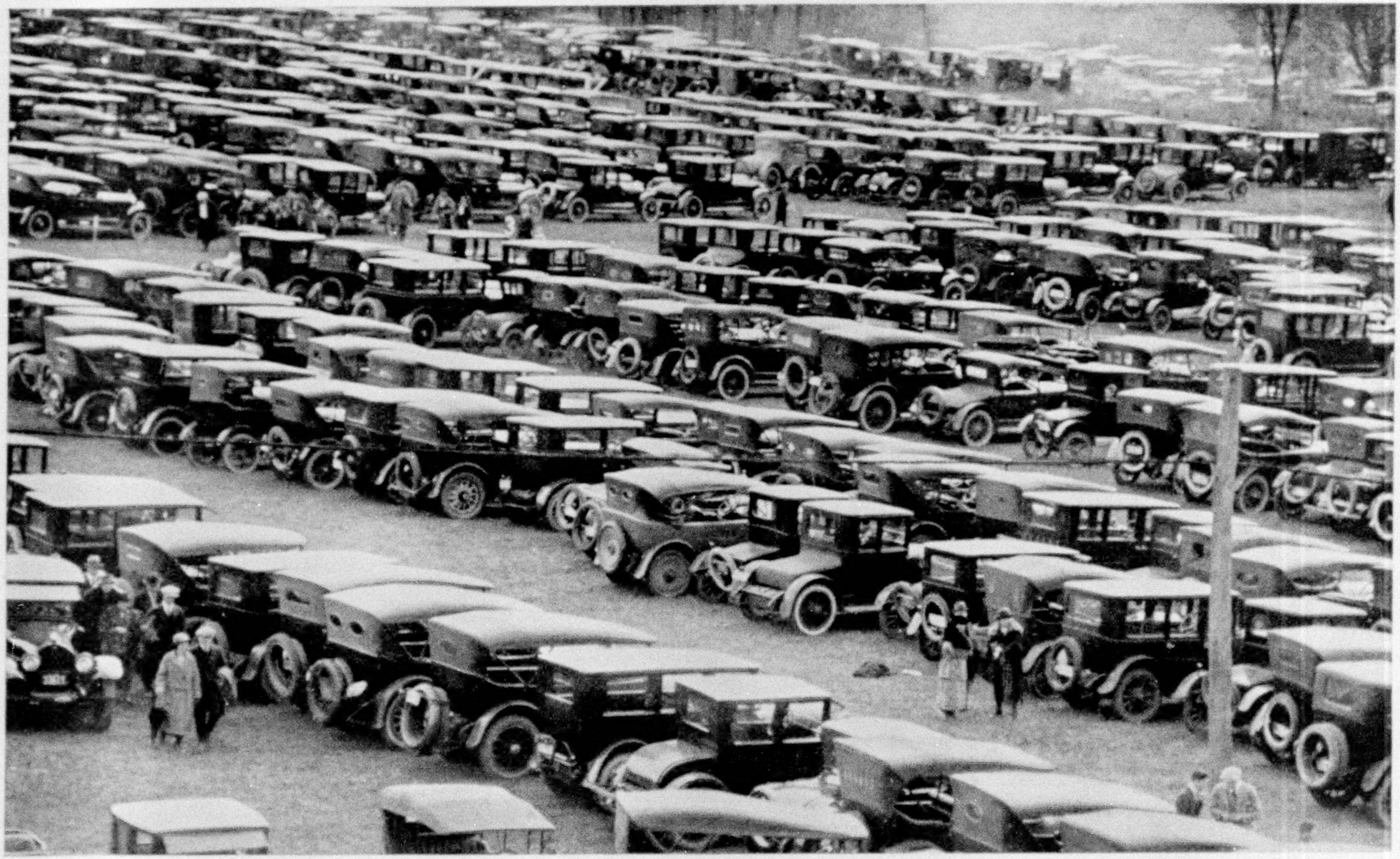


© Ewing Galloway

HEAVY GOING IN THE WAKE OF A RAINSTORM IN THE CEDAR BREAKS REGION OF SOUTHERN UTAH

It is estimated by the National Motorists' Association that two and a half million car-owners annually take to the roads of the country for a vacation, and this number represents about ten million tourists.

XUM



Photograph by International Newsreel

THEIR OWNERS ARE WATCHING THE YALE-IOWA FOOTBALL GAME: THIS PICTURE WAS TAKEN NEAR THE YALE BOWL

Then the staid manufacturer of a staple chassis that has stood the test of years finds that, if the new types are not to undermine his sales, he must meet the competition, and so he sets about to do so, with the result that a new fashion becomes a settled part of the industry.

WHEN MILADY SETS THE PACE FOR EASE AND SAFETY

Statistics have been gathered which show that the ladies have an unsuspected voice in the selection of the family motor car. This is causing most manufacturers to cater to their tastes with great care.

One company puts a thermos bottle in as standard equipment. Another makes his oil-draining system so easy of operation that a woman can drain the crank case without difficulty. Another groups the instrument-board equipment under one glass, so that the board can be kept looking like new.

Still another puts on an improved type of brake-equalizer, so as to insure, in a measure at least, Milady driver against skidding. Gear shifting and clutch operation have been made easier to catch her eye. Accelerator pedals have been redesigned, so that they function equally well with high-heeled dress boots and low-heeled sport shoes. Spark and gas control levers on the steering wheel are being redesigned to obviate the danger of feminine fingers being caught between the control sectors and the steering-wheel spokes when turning corners, and to lessen the risk of stray ends of the woman driver's finery being torn in the control mechanism as she drives to the next bridge party.

One manufacturer provides for automatic recranking in case she stalls her engine, and another takes steps to insure a better mixture in a cold engine or in a sudden acceleration of the motor.

TAKING YOUR BED WITH YOU

In an attempt to capitalize America's love for camping out, one car builder has announced a model in which the Pullman berth idea is copied. Press a button and the back of the front seat drops down. Reverse the cushion on the rear seat, and lo! you have a bed inside your car! Tents eliminated, you are ready to make your bed wherever night overtakes you—by a babbling brook, under a fine willow, or wherever fancy dictates.

The maker of a standard, medium-priced car was asked what he thought would be the future trend of car design for the masses. He replied that his factory was working toward the time when it would put out a model weighing about 1,800 pounds and accommodating four instead of five passengers.

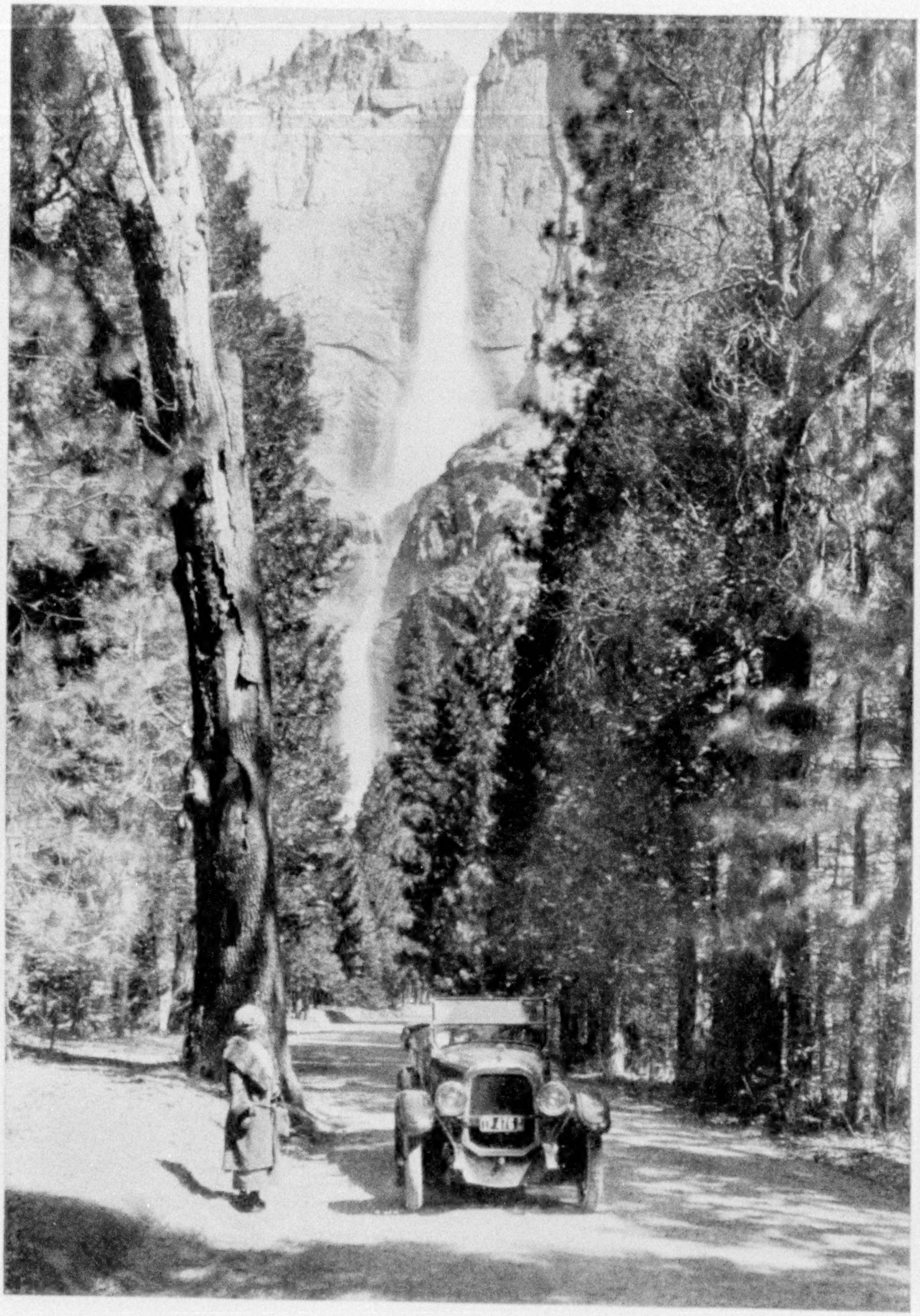
In no other field does one find such close coöperation as in the motor-car industry. The manufacturers in the early days were forced to unite for the purpose of fighting hostile legislation and for making the American public motor-minded. They found that they could make a better market for their individual cars by teamwork with their competitors in selling the car idea. They learned that their success was linked with their competitors' success.

"COÖPERATIVE COMPETITION"

So "coöperative competition" became their watchword. Young, virile men with imagination made this policy a tremendous success, so much so that they agreed among themselves to form a pool of ideas. In this pool there are about 500 patents, and every member of the National Automobile Chamber of Commerce, which includes practically all the leading manufacturers, voluntarily agrees to let every other member use any or all of the features of construction and equipment owned by them individually without the payment of royalties or other compensation. They hold that the better service all cars render the greater will be the demand for their own.

One of the interesting organizations within the industry is the Society of Automotive Engineers. Its main purpose, when organized, was to promote standardization among manufacturers, but it has found its principal continuing mission to be that of a research body serving as a clearing house in automotive engineering and design development.

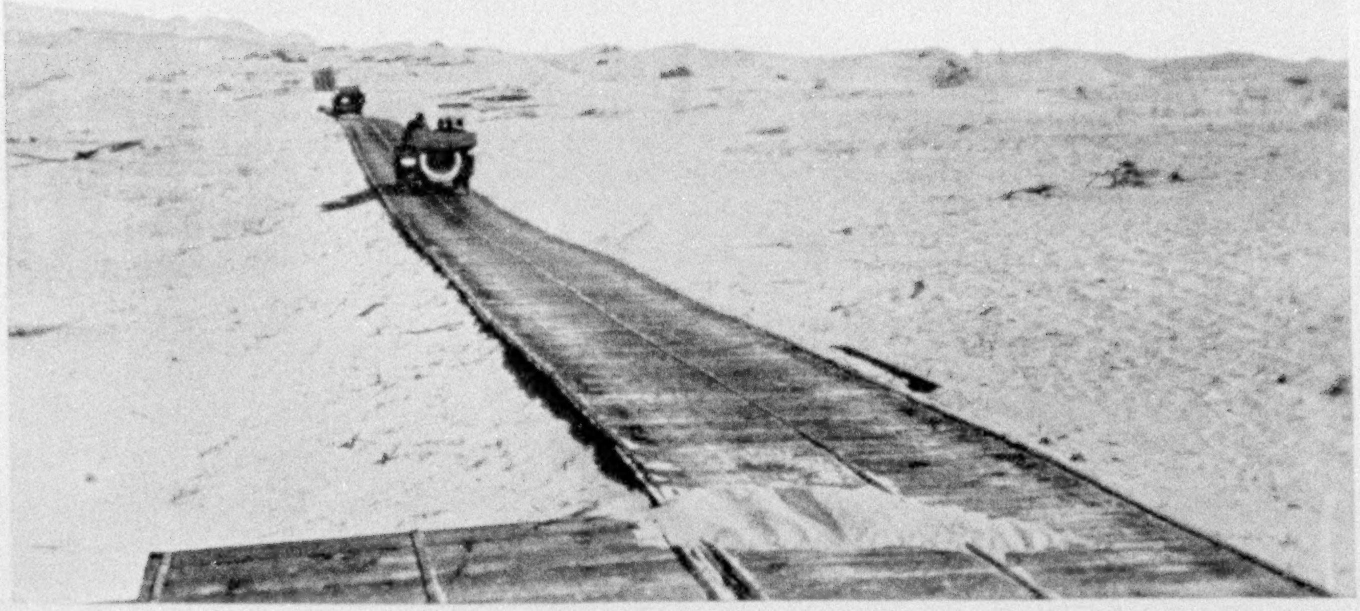
Standardization has been a big task. The fixing of metal standards has assured a consistent and dependable product to the discomfiture of foreign manufacturers. Sizes in wheels and cotterpins, threading of spark plugs, details of tire



Photograph by Charles M. Miller

AT THE FOOT OF YOSEMITE FALLS: YOSEMITE NATIONAL PARK

It is only a little more than twenty-five years ago that the first sale of an automobile was made in this country. The National Motorists Association estimates that more than 2,500,000 car owners will this year use the automobile highways in visiting America's many points of interest.



A COMPLETED STRETCH OF PLANK ROAD OVER THE CALIFORNIA DESERT

Note the turnout in the left foreground. These are built at frequent intervals. Such a road would not be practical where there was excessive shifting of sand dunes.

fastenings, angles of valve-seating, and scores of other items that could be made to fit all cars without detracting in the slightest degree from the engineering originality in car construction that differentiates one car from another, have been standardized, and this standardization lies at the base of quantity production, which, in its turn, plays a fundamental part in American supremacy in the automobile field.

It was found that one company making lock washers for the automobile manufacturers was obliged to make 800 different kinds of washers for bolts ranging from three-sixteenths to one-fourth of an inch in diameter.

It was likewise discovered that the automobile manufacturers were using 1,600 different sizes of steel tubing. Standardization has reduced the number of sizes of washers and tubing to a minimum, with saving in cost of manufacture, reduction of inventory, and convenience to the public.

HOW AUTOMOBILE RACING GIVES THE PUBLIC BETTER CARS

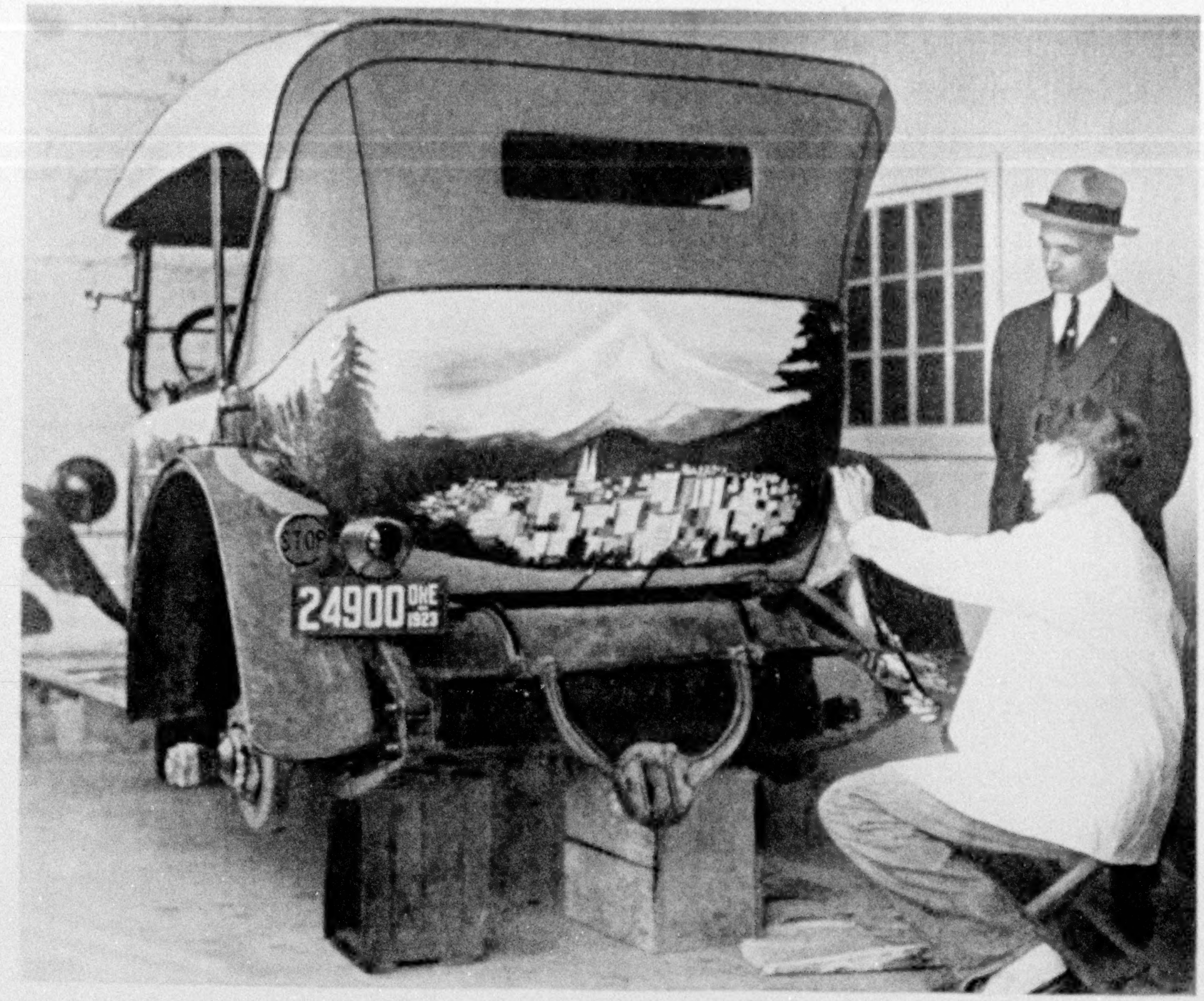
In the early days automobile racing was indulged in for the purpose of showing that cars could get over the road at all, and such races as that sponsored by newspapers in 1895 seem ludicrous at this distance.

Later, people began to think of speed. They wanted cars that could make thirty miles an hour, and the car that showed the most speed was the one that found the readiest sale.

In one of these races for advertising purposes, Henry Ford himself took part in a contraption he called the "Arrow." He undertook to run it a mile straightaway over the ice. The ice looked smooth, but when he got up speed he found it was covered with fissures. To call off the race would be throwing his advertising into reverse gear. So, in his words, "I let the old 'Arrow' out. At every fissure the car leaped into the air. I never knew how it was coming down. When I wasn't in the air, I was skidding, but somehow I stayed top side up and on the course."

Some years later road racing came into vogue, and it did a vast deal in the development of motors, the evolution of spring design, the perfection of ignition, and the solution of lubrication problems.

After the road races came the reliability runs, made under conditions that found the weak spots in the stock cars



Photograph by Pacific and Atlantic Service

THE OREGON STATE MOTOR ASSOCIATION PLANS TO TAKE OREGON SCENERY ABROAD

The back of the Association's pathfinder car is being painted with a scene showing Mt. Hood, with the city of Portland in the foreground.

put under test, and they, in turn, served to shake down engineering standards to the level of dependability.

But later came the speedway races. To them came the best ideas the ablest engineers in the world could evolve, to be put to the grueling tests that only a speedway race can set up. The first speedway built was at Indianapolis, with James A. Allison, A. C. Newby, and Carl G. Fisher as the moving spirits in its construction.

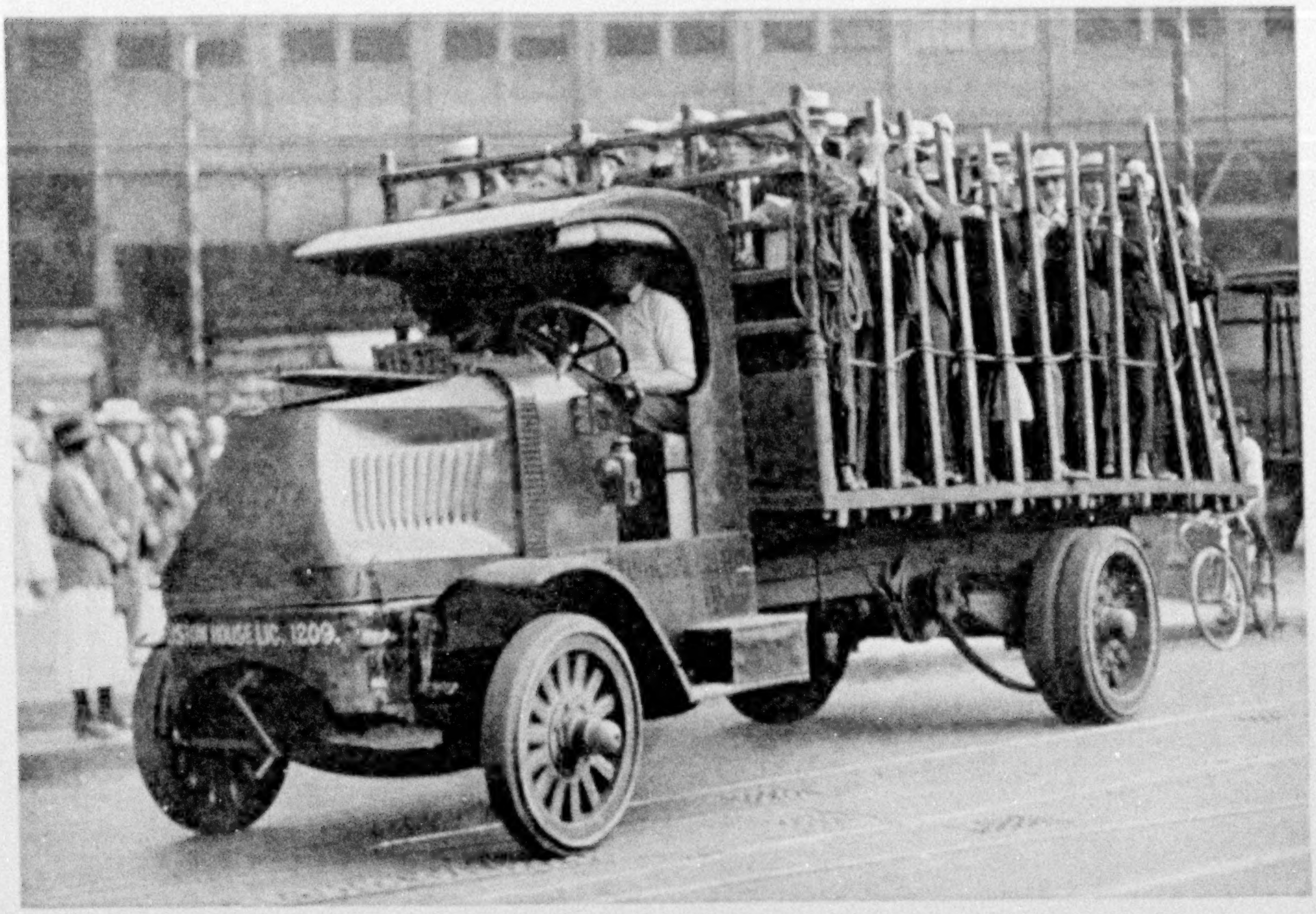
The roadbed was built of earth, like a country highway, but after the first test of 500 miles the conditions were found to be dangerous and unsatisfactory, and straightway it was rebuilt of brick and made to simulate street conditions. No car ever entered one of the races thereafter and went through the grueling test without revealing its weak points.

Every automotive engineer in the profession seeks to know as fully what to avoid as what to incorporate in his future models. The result has been that these terrific tests at Indianapolis have always brought the engineering talent of the country together.

Under the lessons learned there—and obtainable in no other manner, since bench tests cannot develop road conditions—cylinder displacement has been reduced, fuel economy has been evolved, and safety has been forged into every element of your motor car and mine on the mighty anvil of a speedway and under the powerful hammer of high speed. Harmony, balance, dependability, tire mileage, and sturdiness have come from the flaming forge of a hundred miles an hour (see illustrations, pp. 344 and 345).

THE ROMANCE OF QUANTITY PRODUCTION

Quantity production is, after all, the foundation stone upon which rests the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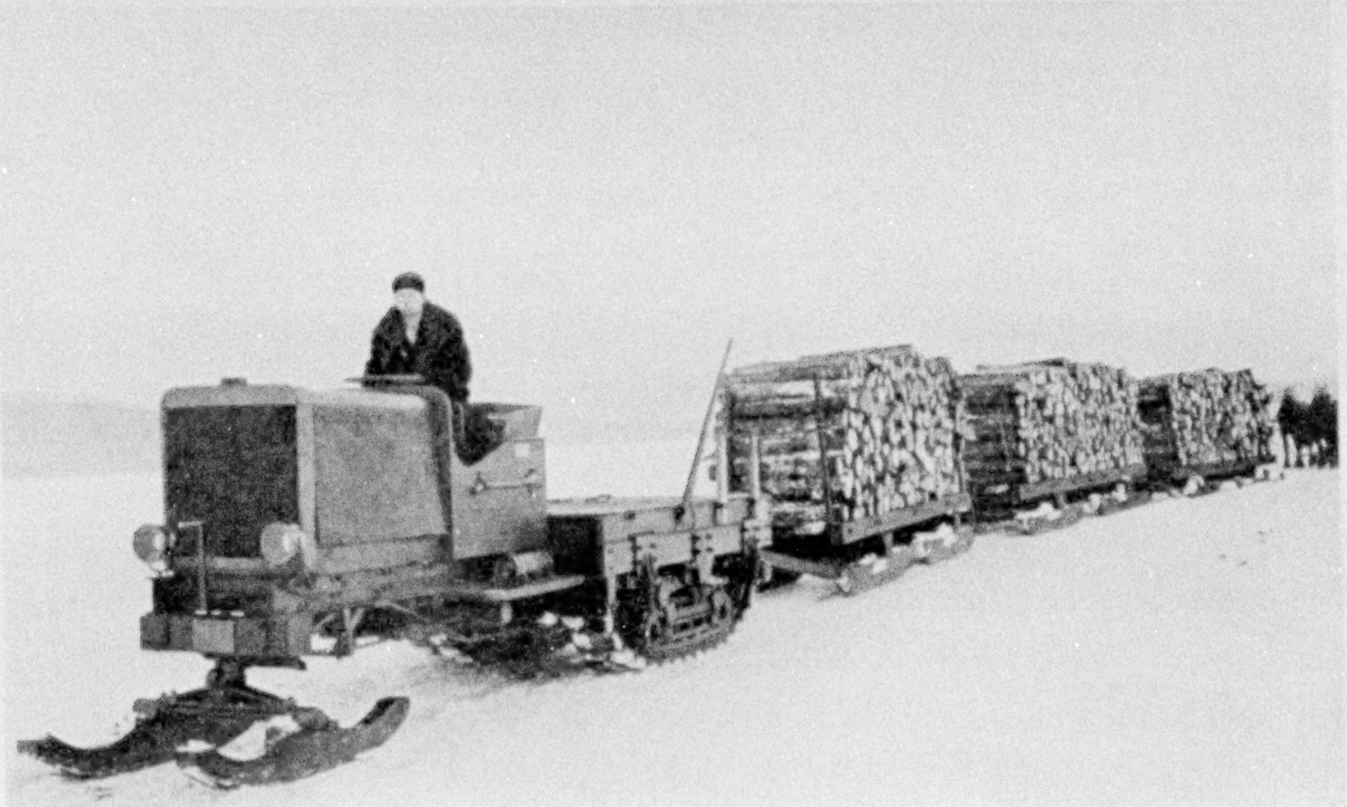
MOTOR TRUCKS PROTECT THE PUBLIC DURING STREET-CAR STRIKES

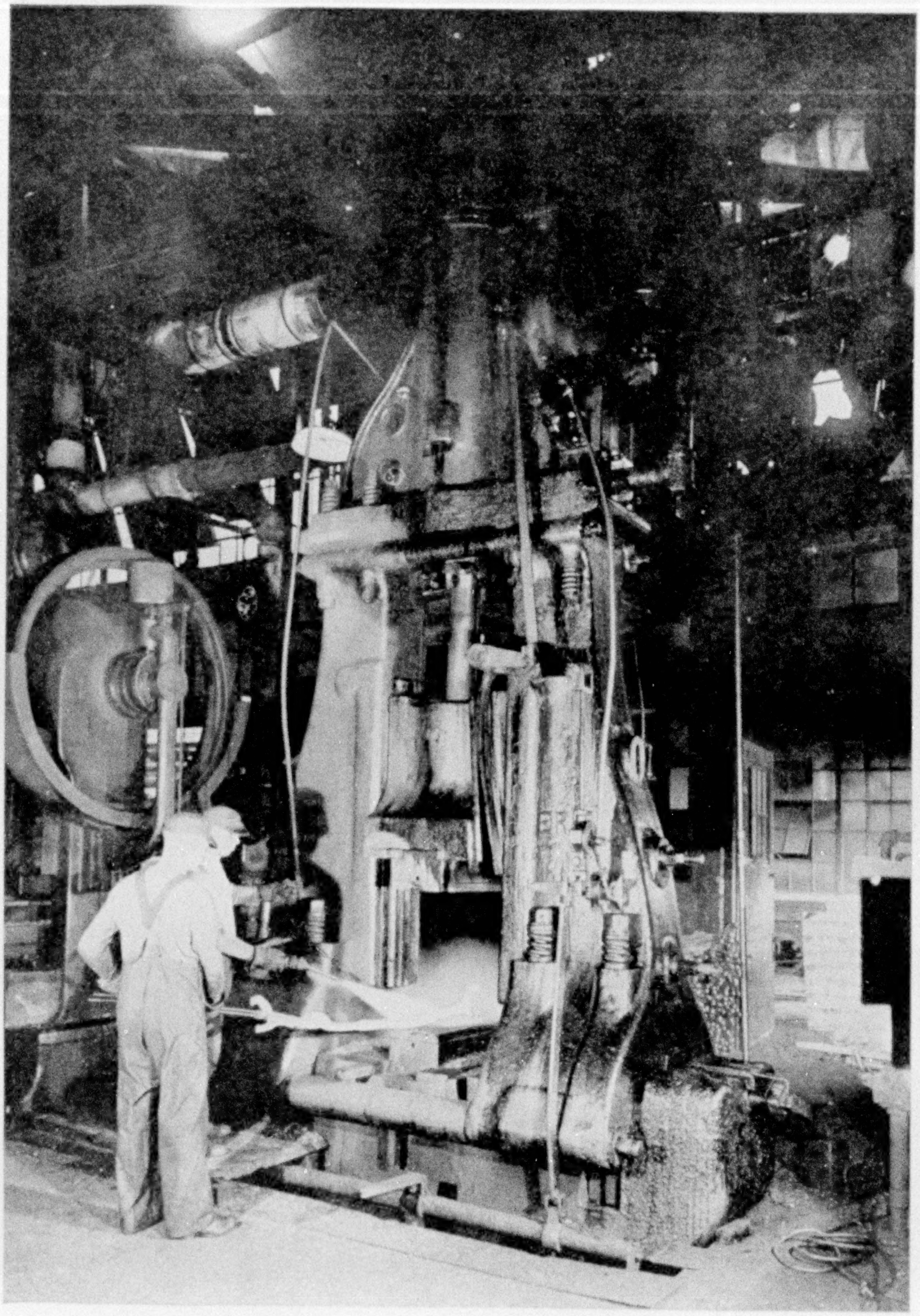
In many cities motor cars have helped the public get down town when the street-car service has been interrupted.



Photographs by Paul Thompson

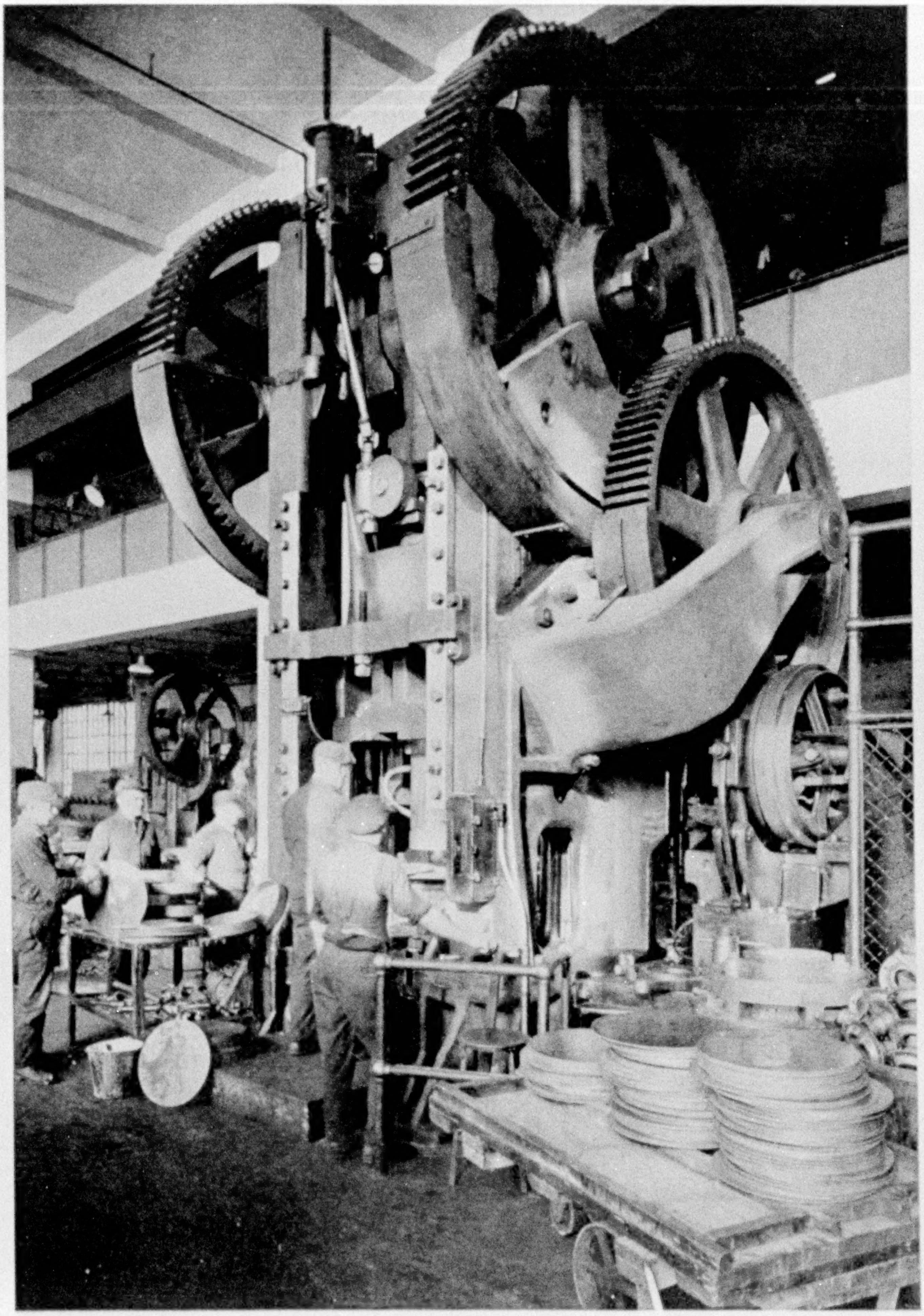
HAULING PULP WOOD IN THE MAINE WOODS

By combining truck, tractor, and bob-sled, the Maine lumbermen have found a practical way to move pulp wood, used in the manufacture of paper, over the ice and snow in winter.



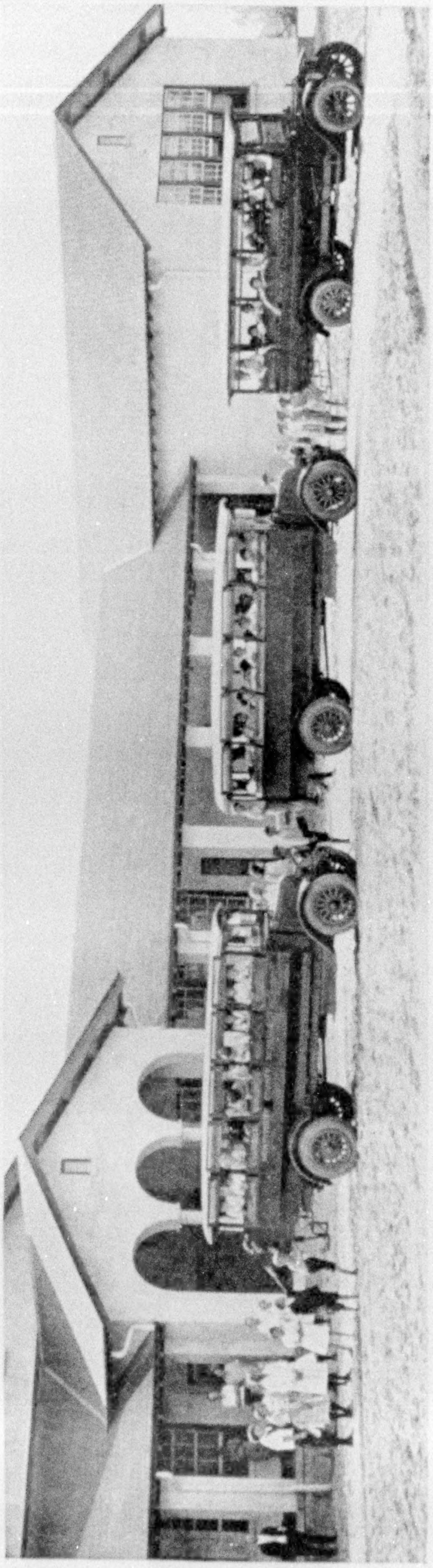
DROP-FORGING A FRONT AXLE

After the heat treatment the axle ingot comes to this big, four-ton hammer and is forged into shape. This machine can be so delicately operated that it can be made to tap a watch without breaking the crystal (see text, page 400).



THE TYPE OF PRESS THAT MAKES BRAKE DRUMS

The flat disks from which the brake drums are made are cut out of sheet steel like cookies out of dough. They are then fed through the machine here shown and are pressed into drums, as shown at the left.



STUDENTS LEAVING THE PINE LEVEL, ALABAMA, JUNIOR HIGH SCHOOL

success of the automotive industry. Without it motor cars would certainly be beyond the means of millions of persons who now own them. In the early days they were largely made by hand. Today the use of a paint brush or a pair of spanners, the movement of a lever, or the holding of an electric wrench represents about the limit of handwork in motor-car manufacture. That precision tools are superior to human senses in automobile making has been strikingly demonstrated.

CLIPPING MINUTES IN MOTOR MAKING

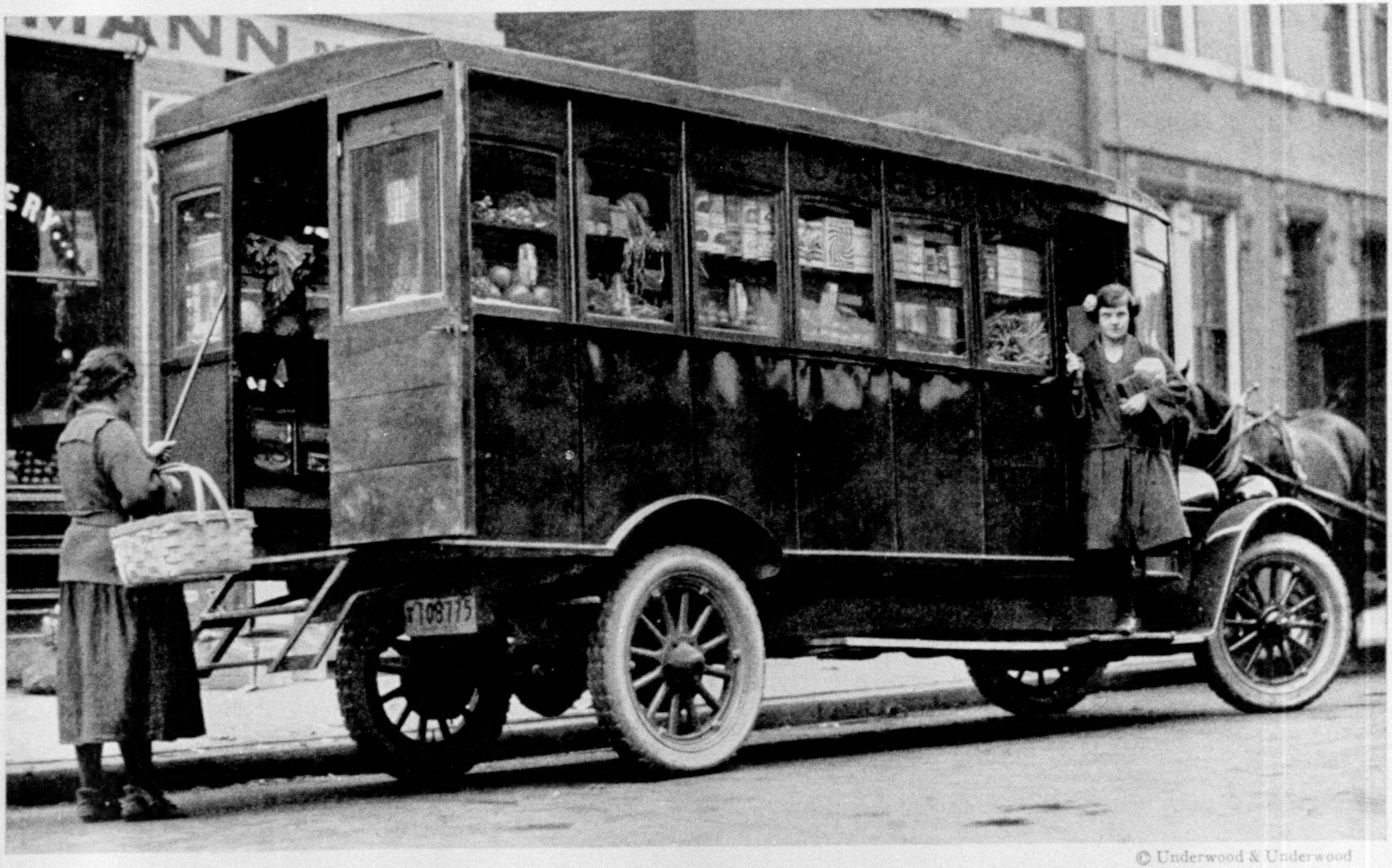
In the early days the material for the assembly of a car was simply dumped together in a space on the floor where the automobile was to be set up. Then the Ford Motor Company thought to try out the overhead trolley system used by the Chicago packers and a division of labor.

One man could assemble a flywheel magneto in twenty minutes. When the moving line was installed and divided into twenty-nine operations, the time was cut down to less than fourteen minutes. By raising the height of the line eight inches, so as to save stooping, the time was reduced to seven minutes. Other experiments reduced the time to five minutes.

In 1913, 9 hours and 54 minutes were required to assemble a motor in the Ford plant. Six months later the time had been reduced to 5 hours and 56 minutes.

By early methods 12 hours and 28 minutes was the time required to assemble a chassis. Then the idea was evolved of towing the chassis down a 250-foot line with a rope attached to a windlass. Six assemblers walked down the line, picking up parts from various piles and attaching them as the car moved. This speeded up the assembly to 5 hours and 50 minutes. By placing the work waist-high and bringing the speed of the conveyor to the most effective point, the time of assembly was reduced to 1 hour and 33 minutes.

It was quite a task to determine at what speed each conveyor should move so as to give each workman ample time to do his bit properly and yet economize every second. The flywheel magneto assembly line was tried at sixty feet a minute, and that proved too fast. Eighteen feet per minute proved too slow. Forty-four feet finally proved to be the correct velocity.



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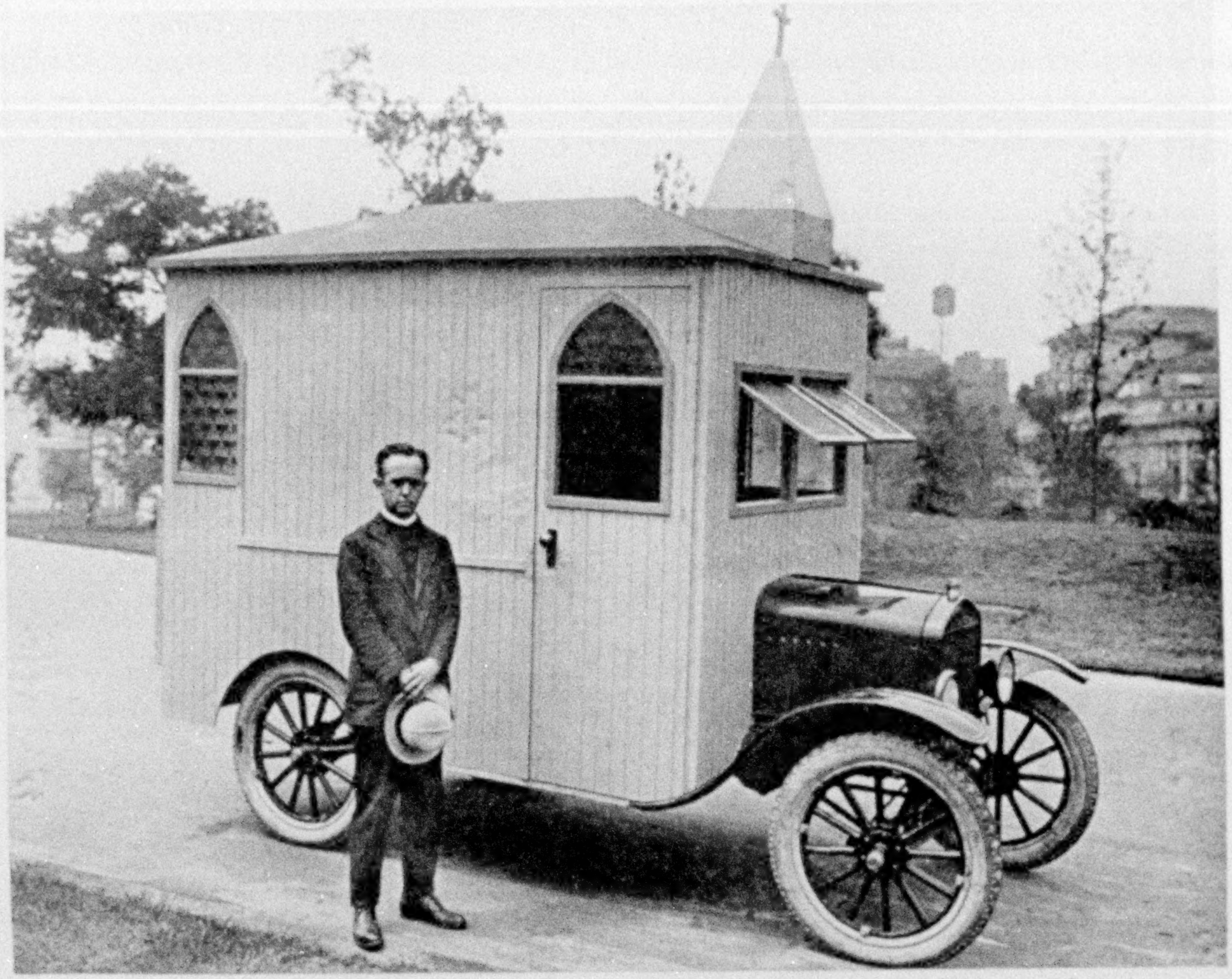
NOW COMES THE TRAVELING GROCERY

A Cincinnati grocer decided to try a "help yourself and pay as you leave" store on wheels. He found the venture so profitable that he proposes to add other cars to his fleet.



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A PREACHER AND HIS PERIPATETIC PULPIT

A Brooklyn clergyman decided to fulfill literally the admonition to "go out into the highways." His traveling chapel has stained-glass windows, a small organ, and a steeple that can be lowered to permit passage into a garage.

In a leading plant the chassis assembly line moves at six feet per minute and has forty-five operations. The first man puts on the mudguard brackets, the motor arrives in the tenth stage, and so on. Some men do only one or two small operations. The man who places a part does not fasten it; the man who puts in a bolt does not put on the nut; the man who puts on the nut does not tighten it.

On operation No. 34 the motor gets its gas, having received its oil earlier. At station No. 44 the radiator is filled with water, and at No. 45 a button is pressed, a pair of rollers in the floor under the rear wheels begins to revolve rapidly, the wheels spin, the engine turns over, and the car glides away under its own power with a driver at the wheel.

Going back a little, the molding in the foundry is all done by machinery. A line is adapted to the making of a single type of casting. In the casting of the engine block there are three lines with a capacity of 5,000 blocks every eight hours, or 15,000 when working three shifts a day. The making of the molds and cores and the packing of the cores are all done while the line moves. At another point the molten metal is poured, and by the time the mold reaches the end of its journey, the casting is cool enough to start on its automatic way to cleaning, machining, and assembly.

UNPRODUCTIVE STEPS ELIMINATED

The piston and connecting-rod assembly is another illustration of the elimination of lost motion in the industry. Under the old plan a man assembled twenty pistons and rods an hour, and subdivision of work didn't seem to promise much saving.

The workman pushed the pin out of

Photograph from E. E. Pierson

A MOTORIZED TYPEWRITER SALES SERVICE

A Bloomington, Illinois, typewriter agency decided to send its salesmen on the road with a full line of samples. A specially designed automobile body was installed, and now the typewriter store travels from town to town and from office to office. Each machine is mounted on a board that can be pulled out and made to serve as a demonstration desk.

the piston, oiled it, slipped the rod in place, replaced the pin, tightened one screw and opened another.

Then came a foreman with a stop-watch. He found that four hours out of every nine were spent taking steps. He subdivided the work into three operations, eliminated unproductive stepping, and now there are 46 pistons assembled per man-hour.

Painting the rear axle was an operation that took two men several minutes; new machinery was devised, and now it is a thirteen-second job for one man.

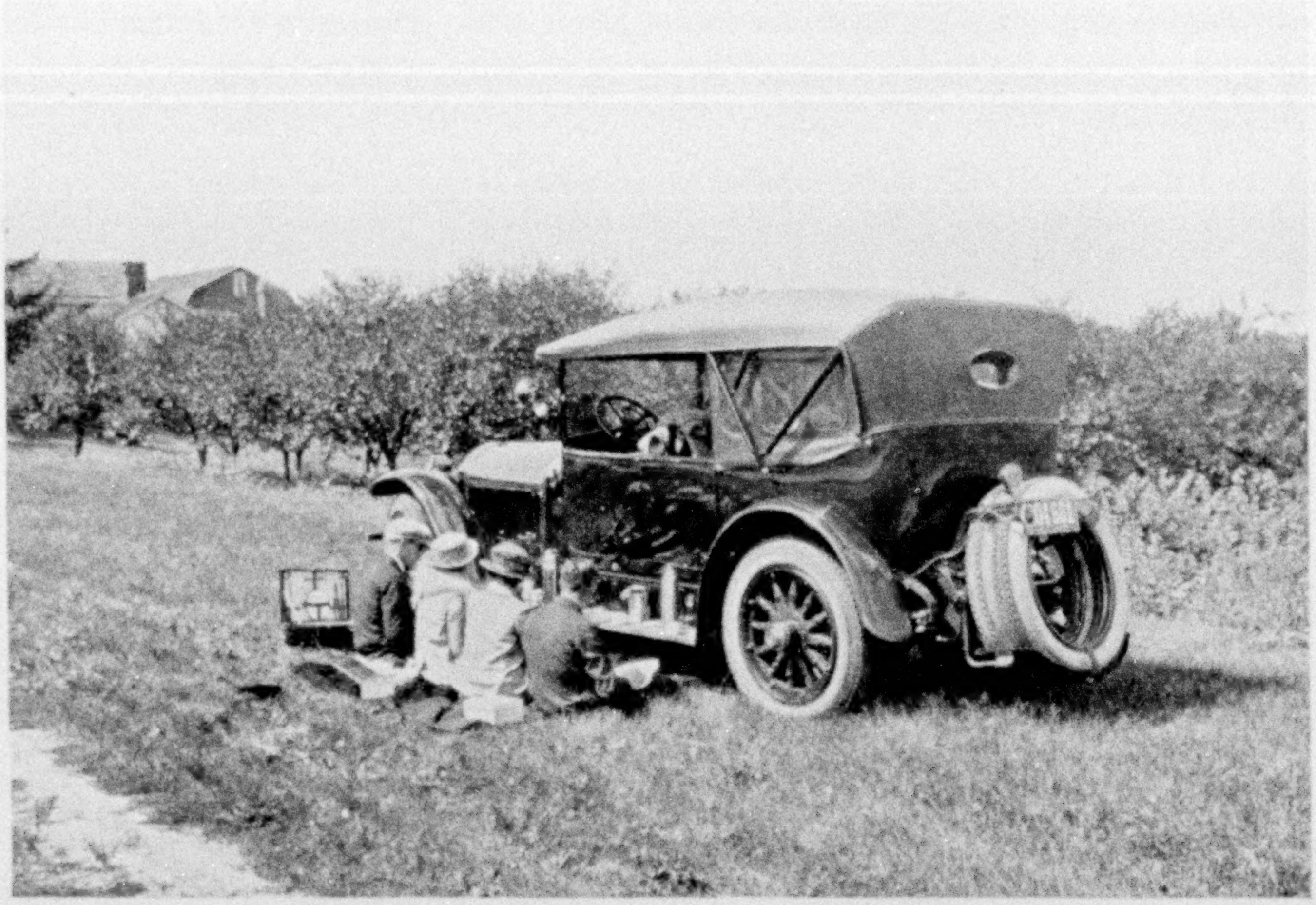
With its ninety-five tubes, a radiator, even on a Ford, is a rather complex affair. Fitting and soldering these tubes by hand was a long operation, requiring many skilled men. Now a machine is in use which can make 1,200 radiator cores in eight hours, the soldering being done by moving the radiator through a furnace on a metal conveyor, which entirely eliminates the tinsmith.

SUGGESTIONS FROM THE RANKS

Suggestions come from everywhere in the average quantity production automobile factory, and especially from the ranks. In one plant a Polish workman who could speak no English found that if the tool in his machine were set at a different angle it would wear longer. That discovery saved thousands of dollars in tool-grinding. Another, running a drill press, rigged up a little fixture to save handling after drilling. Tens of thousands of dollars are saved annually by it.

A proposal that castings be taken from the foundry to the machine shop on an overhead conveyor saved seventy men in the transport division.

Seventeen men were required, when production was much smaller than now,



A WEEK-END ALONGSIDE ONE OF NEW YORK'S STATE HIGHWAYS

Photographs by George R. King

BUYING PEACHES ON A NEW YORK STATE HIGHWAY

Motorists in New York and New England find everything, from apples and peaches to eggs and jellies, offered for sale by the roadside; and the prices are usually surprisingly low.

to remove burrs from gears. A mechanic roughly designed a machine to do the work. It was perfected, and now four men have several times the output of seventeen, and none of them works as hard as any of their predecessors.

Another man suggested a welded rod instead of a solid one in the chassis, and the resultant economy meant more than half a million dollars a year in this plant. An improvement in heat-treating camshafts reduced the need of shaft straighteners from 37 to 8, although production has nearly doubled.

THE STORY OF THE GEAR-WHEEL DIPPER

Does the reduction of the intricacy of the work a man performs deaden his initiative or reduce the value of his work to the industry? Many people have asked that question.

WASHINGTON
COUNTY
FREE
IBRARY

Photograph by Clifton Adams

BOOKS COME BY MOTOR TO GLADDEN THE LIVES OF THE COUNTRY CHILDREN

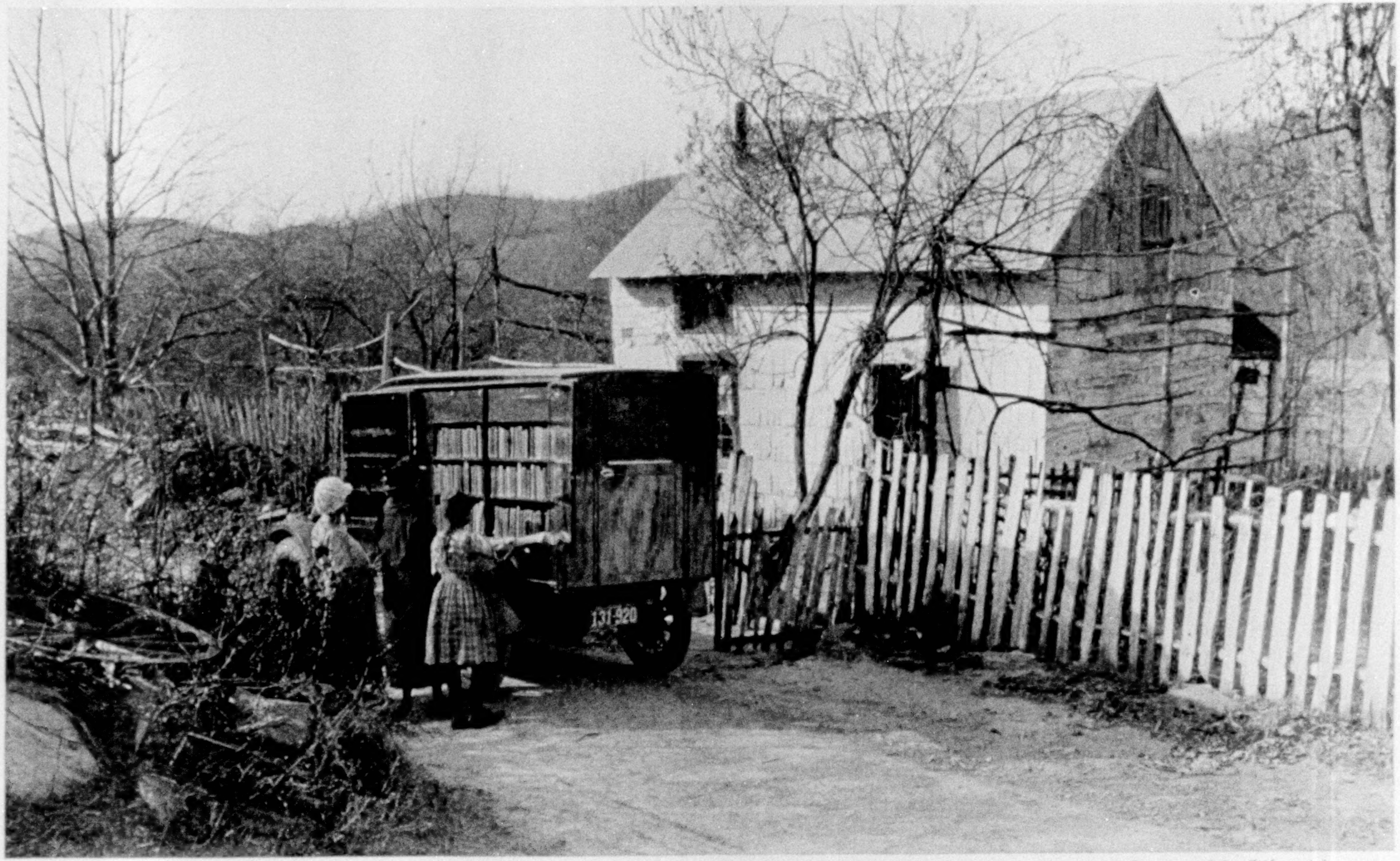
Many counties are introducing a motorized circulating library service for the rural districts.

In one factory I visited, perhaps the most monotonous task is that of a man who picks up a gear with a steel hook, shakes it in a vat of oil, and then places it in a basket. The monotony of the motion required never varies, and is done without either muscular energy or mental activity. He has done that same job for eight years and has refused offers of promotion. But he has saved $40,000, owns his own home, and drives his own car. It is said that a thorough study has not revealed in that factory a single case of a man's mind being twisted or deadened by such repetitive work.

As to taking skill out of the industry, it is pointed out that, rather, it makes the unskilled laborer partner of the skilled engineer, enabling him, with a mechanism designed by the engineer, to do a job commanding twice the pay he could get without the machine.

LITTLE ECONOMIES THAT MAKE BIG PROFITS

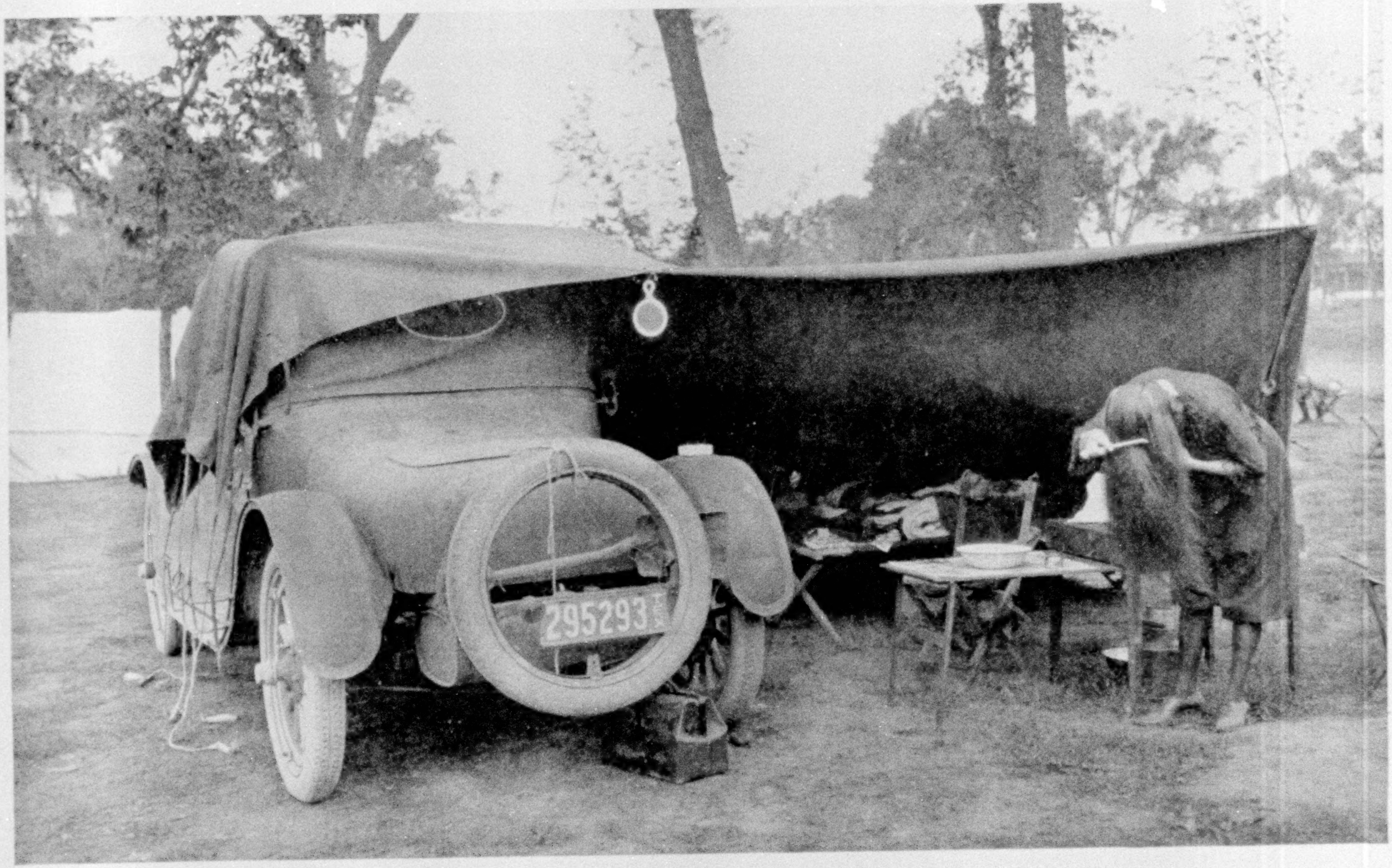
The old-time tool-sharpener was an expert judge of heat temperatures, but his was a hit-or-miss operation. Now the man who heat-treats steel in an automobile factory has nothing to do with the heat. He never sees the pyrometer that tells when the necessary degree of



Photograph by Clifton Adams

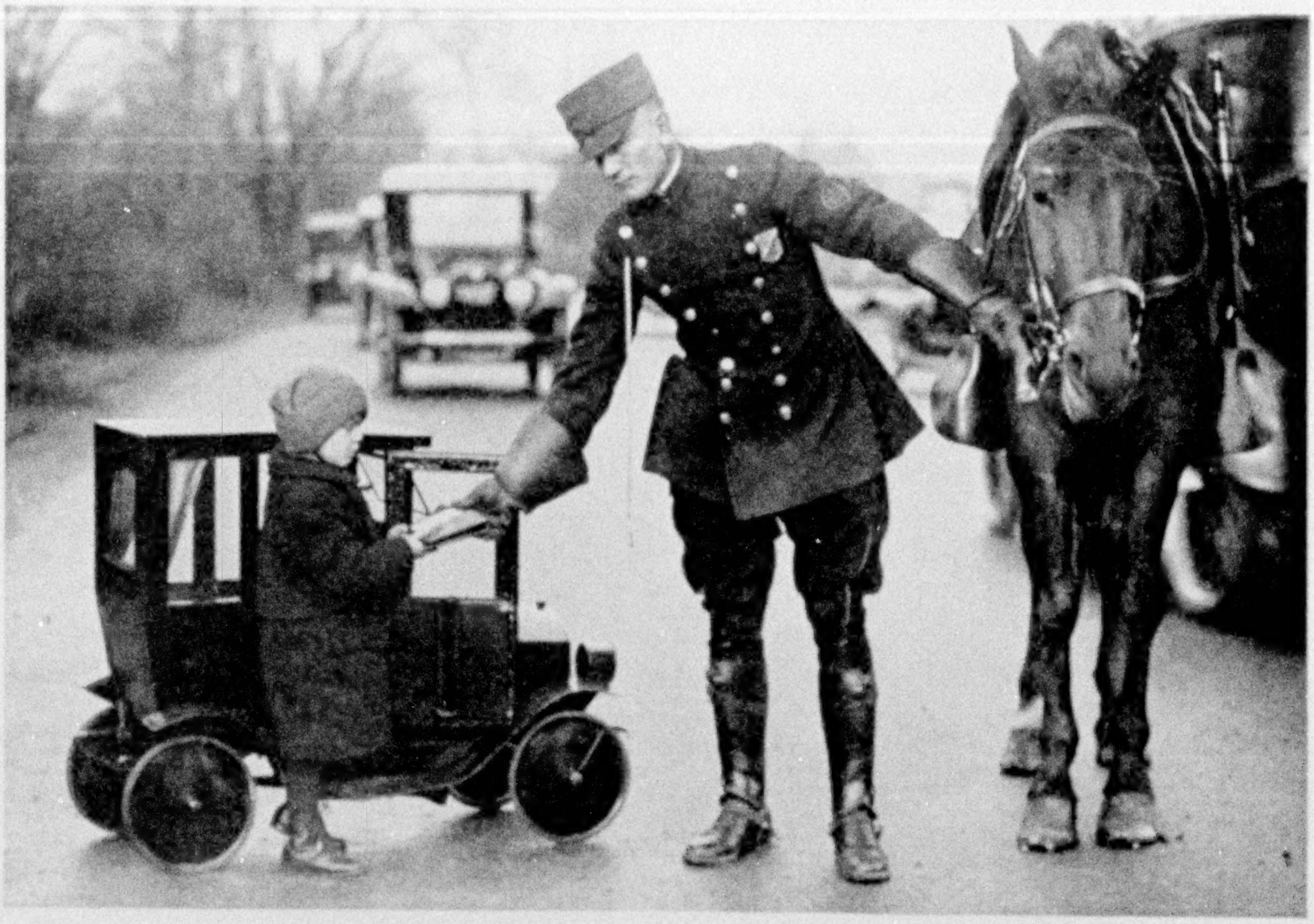
EVEN THE MOUNTAIN COTTAGE FEELS THE TOUCH OF THE AUTOMOBILE

Washington County, Maryland, sends its free library service up into the foothills of the mountains to carry the benediction of books to the poor.



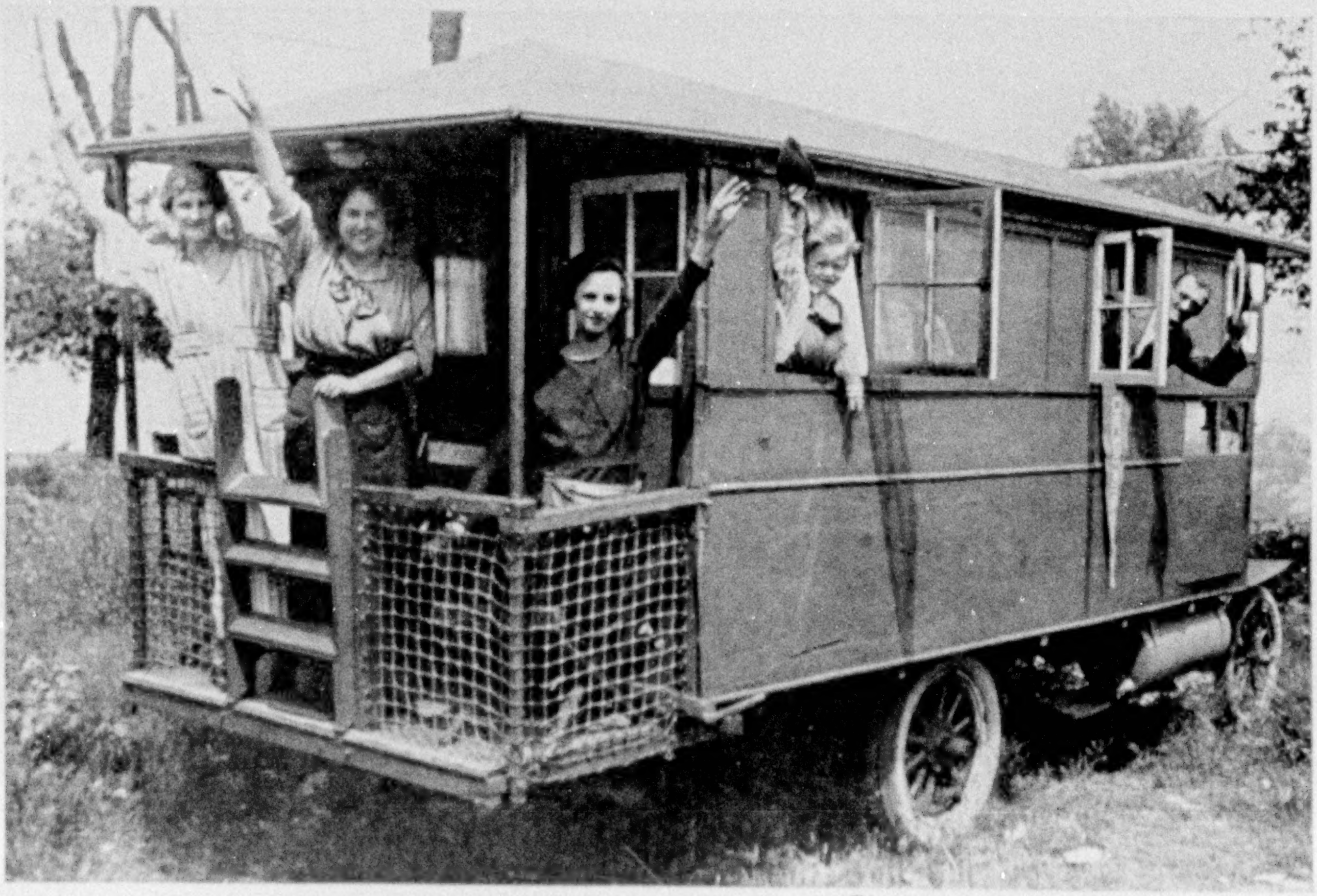
THE MORNING TOILET ON TOUR

Camping outfits of many kinds and degrees of comfort are on the market to-day, and the demand for them is showing a remarkable increase with each succeeding tourist season.



MINIATURE "TWIN-LEG" SEDAN

A Boston mechanic built his son a toy automobile with everything orthodox save an engine. The young motorist insisted on finding a "cop" who would "arrest" him.



Photographs by International Newsreel

SEEING THE COUNTRY GYPSY FASHION

This bungalow car, fitted with the comforts of a modern apartment, including electric lights and plumbing and a convertible living and bed room, has brought happiness to a motor-minded family. Even the driver's seat can be converted into an upper and lower berth.

A GROUP OF CHILDREN FROM SIX STATES FORMING A HAPPY CIRCLE IN OVERLAND PARK CAMP GROUNDS, DENVER, COLORADO

Hundreds of cities and towns have provided camps for tourists, most of them equipped with electric lights, kitchens and sanitary conveniences, and provided with police protection. One Missouri town of 7,000 inhabitants recently made a count. Its citizens welcomed 23,520 cars, carrying 100,000 passengers, during the touring season. More than 3,000 cars, carrying 12,000 passengers, stopped at the town's free camping site.

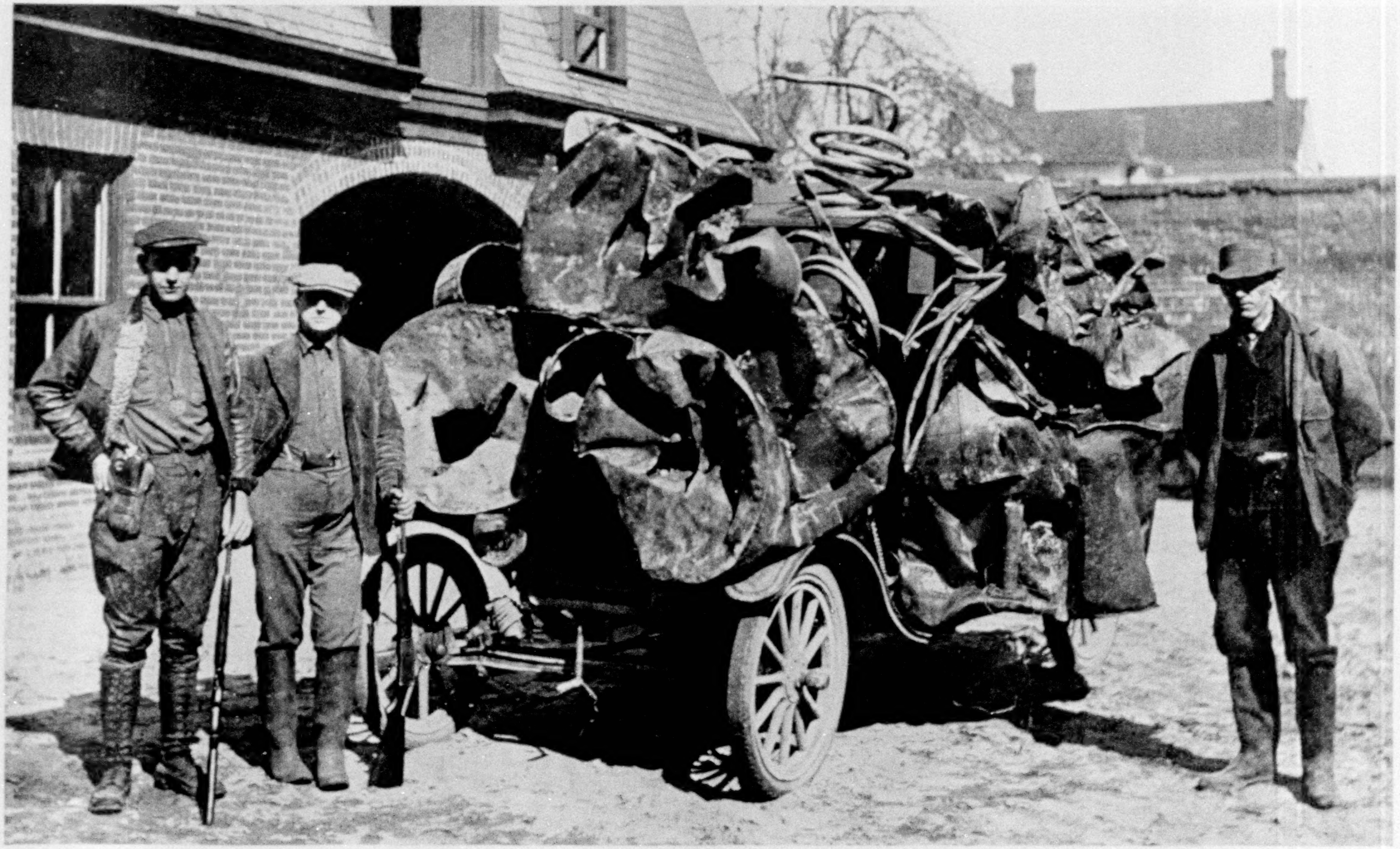
temperature is reached. Colored electric lights are automatically switched on to tell him when to remove the steel.

Even the "flivver" type of car has about 5,000 parts, counting screws, nuts, and all, and assembly on a quantity production basis must be nicely worked out in every plant. A shortage in a single type lock washer or bolt would tie up the whole line; so the flow of parts must always be constant and dependable.

When it is remembered that the saving of a single cent on each car's production cost means nearly $20,000 a year in the case of the Ford, and $5,000 in the case of the Chevrolet, it can be seen what large prizes small economies win in big factories.

In one plant, the sweepings alone represent a saving of more than half a million dollars annually, and the elimination of a single style of bolt means another half million. Making transmissions in the factory, instead of buying them, saves nearly $20,000,000 a year.

To see a big blast furnace tapped, to watch its white-hot stream of molten iron flow off into giant 75-ton ladles, from

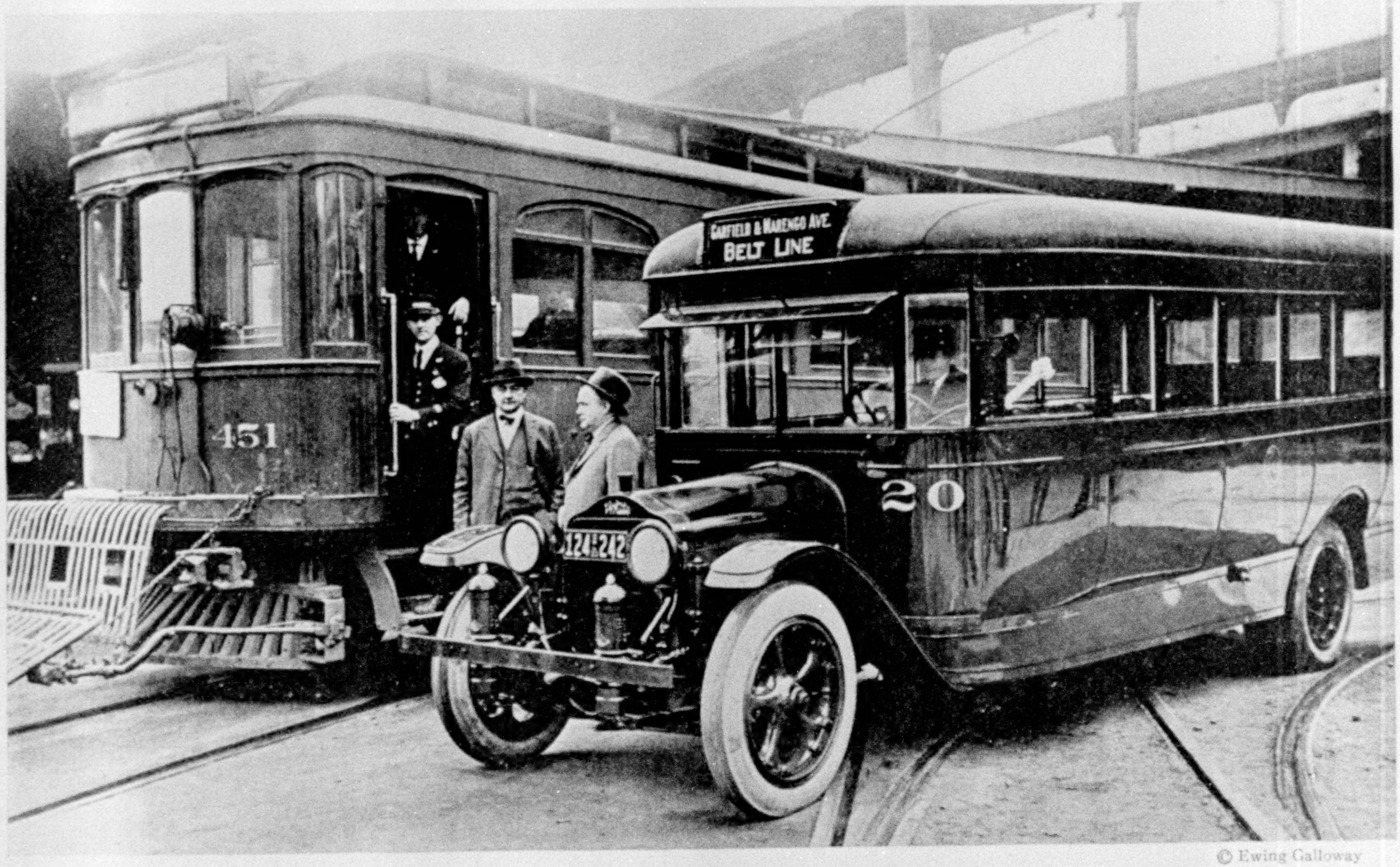


Wide World Photograph

THE REMAINS OF A RAIDED STILL ABOARD A FAITHFUL "FLIVVER"

There is a Ford driver born every thirteen seconds to keep pace with the output of the automobile plants at River Rouge and Highland Park.

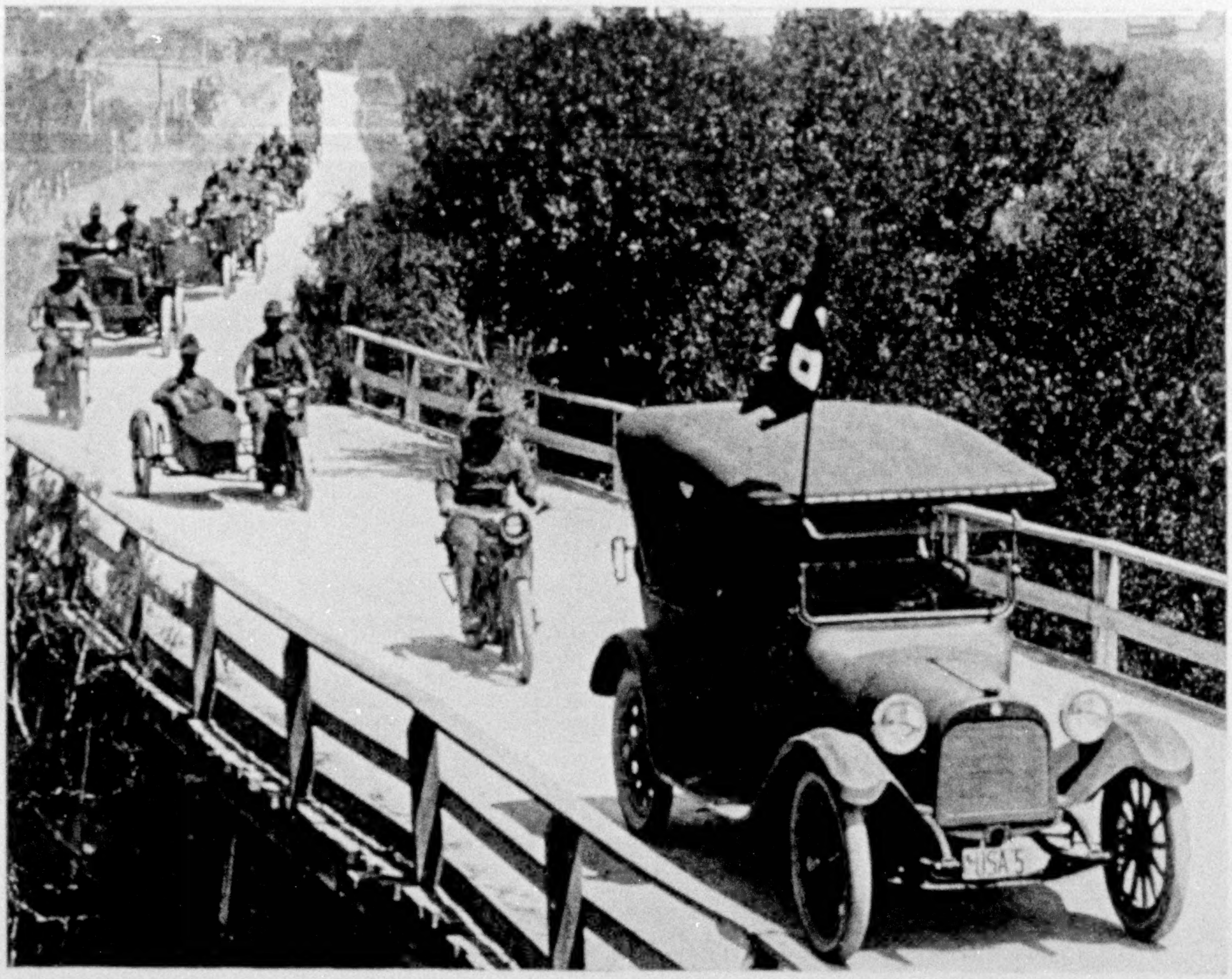
XUM


GARFIELD & MARENGO AVE.
BELT LINE
451
20
124-242

© Ewing Galloway

A MODERN MOTOR BUS AND A CAR OF THE TRACTION LINE IT SERVES

Sixty electric lines are now using motor busses to supplement their service. They serve admirably in new territory as feeders to established street-car and interurban traction lines.



Photograph from the U. S. Signal Corps

MOTORIZED TRANSPORT IN THE UNITED STATES ARMY

which it is then emptied into cupolas, to be, in turn, drawn off in small quantities and poured into waiting molds, is to behold an epic of industry—molten iron from the blast furnace's fierce flames poured into the mold itself, without the intervening pig-iron stage.

Going through the major plants of the industry is an experience one can never forget. Following the main processes in car fabrication, we pass from the foundry, where the fiery liquid is molded into parts, into the forge building, where they are heat-treated and shaped.

Here is a giant triphammer capable of delivering a four-ton blow, and yet so skillfully operated that it can be made to tap a watch without breaking the crystal, or to touch a finger ring so lightly as to leave only a slight grease mark thereon (see page 386); there, a tremendously powerful press that shapes a crankshaft with the seeming ease with which a child presses out a mud pie.

Elsewhere we see a battery of pots, using, in heat-treating various parts that are to be subjected to hard wear and rough usage, enough molten cyanide every day to kill all the people in the Western Hemisphere (see page 376).

Leaving the forge department and passing on to the machine shop, one encounters a thousand mechanical marvels. There one sees immense multiple drill presses, some of them capable of boring more than fifty holes simultaneously in four directions, each perfectly true in its direction, in an engine block; piston-grinding machines that automatically grind four pistons at a single operation, facing the top and turning the outside diameter at the same time; screw machines that automatically feed themselves long steel rods, four or more at a time, and transform them into perfect screws—heads, threads, and slots.

A whole battery of machines in this department is busy milling the "cheeks" on the "throws" of crankshafts, each one doing what formerly required twelve different operations, on as many machines, each manned by an operator.

Photograph by Paul Thompson

A MEMBER OF THE MOTOR CORPS IN THE WORLD WAR

Another battery of machines is cutting teeth on gear-wheel blanks. One man attends a number of them, and all they ask is that he give them a regular supply of blanks and liberal streams of oil over the cutting surface.

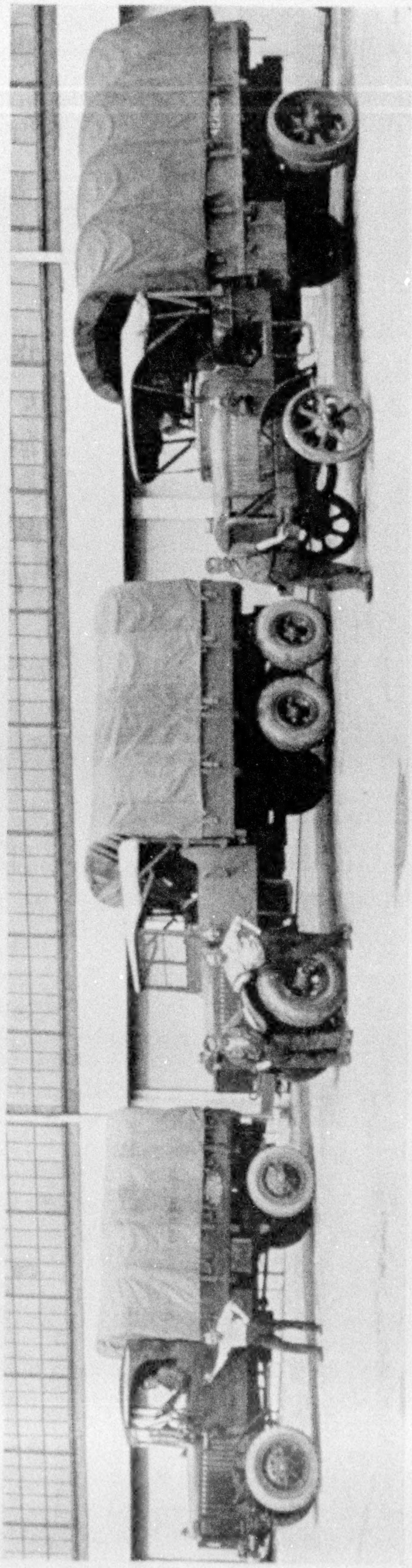
FASHIONING FENDERS AND BRAKE DRUMS

Elsewhere an endless procession of engine blocks is coming down the line, each block being cut and trimmed into shape by powerful cutters to which iron seems little harder than cheese. One type of these milling machines takes a series of blocks and rotates them past the cutting tool instead of moving them one at a time back and forth on a platform. One of these machines takes the place of twelve of earlier design, occupies only a fifth as much floor space, and reduces the human factor to a minimum.

From the machine shop one passes to the stamp-press shop, where other wonders await him—machines that cut blanks out of sheet steel as easily as the housewife cuts cookies out of dough, and much faster; others that transform steel disks into brake drums at one operation; still others that stamp fenders out of sheet steel with a single movement.

Here are spot-welders that baste the two parts of an axle housing together just as a seamstress bastes a sleeve before sewing it. The operator holds the two pieces of steel together, touches a switch, melts a spot on the two edges, and causes the steel to run together. This binds the two parts together for the man who is to finish the job.

One watches cylinder-grinding, where 1/10,000 of an inch is the limit of tolerance in departure from exact size; follows piston-ring inspection with measuring instruments, in which rays of light are made to reveal fine variances that escape detection by ordinary means; studies dynamometer tests that reveal the exact horsepower developed at all speeds; examines the machine that calculates the area of an irregular piece of leather a thousand times as fast as it could be determined by arithmetic! (see page 362).



Photograph by Clifton Adams

ARMY TRUCKS AT CAMP HOLABIRD, BALTIMORE, MARYLAND

The truck on the right is the regulation army truck widely used by our Expeditionary Forces in France. In the middle is the new six-wheel truck recently devised (see page 404). By the use of oversized tires, the ratio of weight per square inch on the road surface is reduced from 7 to 2½. The truck at the left is also a new design, built at Camp Holabird and having a four-wheel drive. This truck will go almost anywhere that a caterpillar tractor can operate, and at the same time it has a high road efficiency.

Likewise, one is inclined to linger along the assembly lines, watching engines and transmissions and rear axles being built up and coming down to the main line where they meet the chassis and are made a part of it. The paint shop, where the enamel is sprayed on and the steel body is sent on moving platforms through the drying kilns; the upholstery and trimming department—a score of fascinating activities beseech attention, but their "say" must be with pictures (see pages 353-355, 358-360, 362, 363, 366-370, 376, 377, 386, and 387).

The employment of machinery in the making of automobiles and the quantity of product turned out are among the marvels of this mechanical age. If old-time hand methods were used, it is estimated that a single plant in the industry would require two million workmen where now less than 100,000 are employed, and even a "flivver" would cost almost as much as the most expensive car to-day.

A TRIBUTE TO GENIUS

The American tribute to the automotive engineer's genius has made his industry the third largest in the United States and has enabled it to bow petroleum into second place. The automotive vehicle manufacturer has become the largest producer of finished goods in the world.

Looking down the line of motor cars put out, from the Packards, Pierce Arrows, Lafayettes, Locomobiles, Lincolns, Cadillacs, and Marmons, with their superlative standards of construction; to the Fords, Stars, Grays, and Chevrolets, designed to meet the essential requirements of those of moderate means, we find that everywhere there is an amazing amount of mileage in them per dollar invested, when given proper care and operated at speeds consistent with their construction.

H. C. S.'s, Stutzes, Wintons,

Hudsons, Studebakers, Chandlers, Nashes, Franklins, Buicks, Reos, Hupmobiles, Maxwells, Chalmers, Dodges, Durants, Overlands, and many others, offer a range of choice in price and type to meet every taste and every requirement, but any one of them represents a good car within the price range to which it belongs.

It is true that the manufacturers, in the main, make big total profits, but these grow small when brought down to a per-car basis. Most of these profits arise, moreover, by economies. The Studebaker South Bend plant, for instance, spends $3,000,000 for a new foundry; this will pay for itself in the economies of a comparatively short time.

THE HIGH COST OF DISTRIBUTION

The high cost of distribution is one of the striking factors of the automotive industry. The economist who wrote that it costs as much to sell a car as to make it probably went a little beyond the mark, but at that, the margin between the wholesale and retail prices is vastly larger than that between cost of production and the wholesale price.

Economists generally agree that more than one-half the price the consumer pays for the commodities he uses represents the costs and profits of handling them between the producer and the consumer. The late President Harding called this one of the greatest problems of civilization, if indeed not the greatest.

The motor truck has been asked to help solve this problem, and it seems to be making a substantial contribution thereto. A big New York firm found that the ton-mile delivery cost fell from 48 cents with horses to 20 cents with motor trucks.

In Milwaukee, Wisconsin, the milk companies decided to motorize their quantity milk delivery, and the result was a saving of two cents a quart on their product.

A Detroit department store has instituted a new motorized delivery service and now delivers within a radius of 75 miles, giving a vast rural and small-town population a service never before thought possible.

A study of truck statistics shows that eighty-three out of every hundred built last year were of one-ton or less capacity. A quarter of a million trucks were built that year and there are now about a million in commission in the United States.

In most cases where the motor truck has gone into delivery service in competition with the horse, it has been able to cut down the delivery cost in almost as large a proportion as it accelerates the time of delivery. We all love the horse, but economy is the prime consideration of the business world.

The truck also has a vast field before it in handling the short-haul freight that the railroads now handle. Any rail shipment that is for less than forty miles is apt to be carried at a loss. The railroads, it is said, want to give this business to the motor truck. Likewise, they would gladly remove their freight depots from the centers of cities, since the interest on such investments wipes out the profits of package freight handling. They would like to have their freight stations outside of congested districts and let the motor trucks take care of the city delivery.

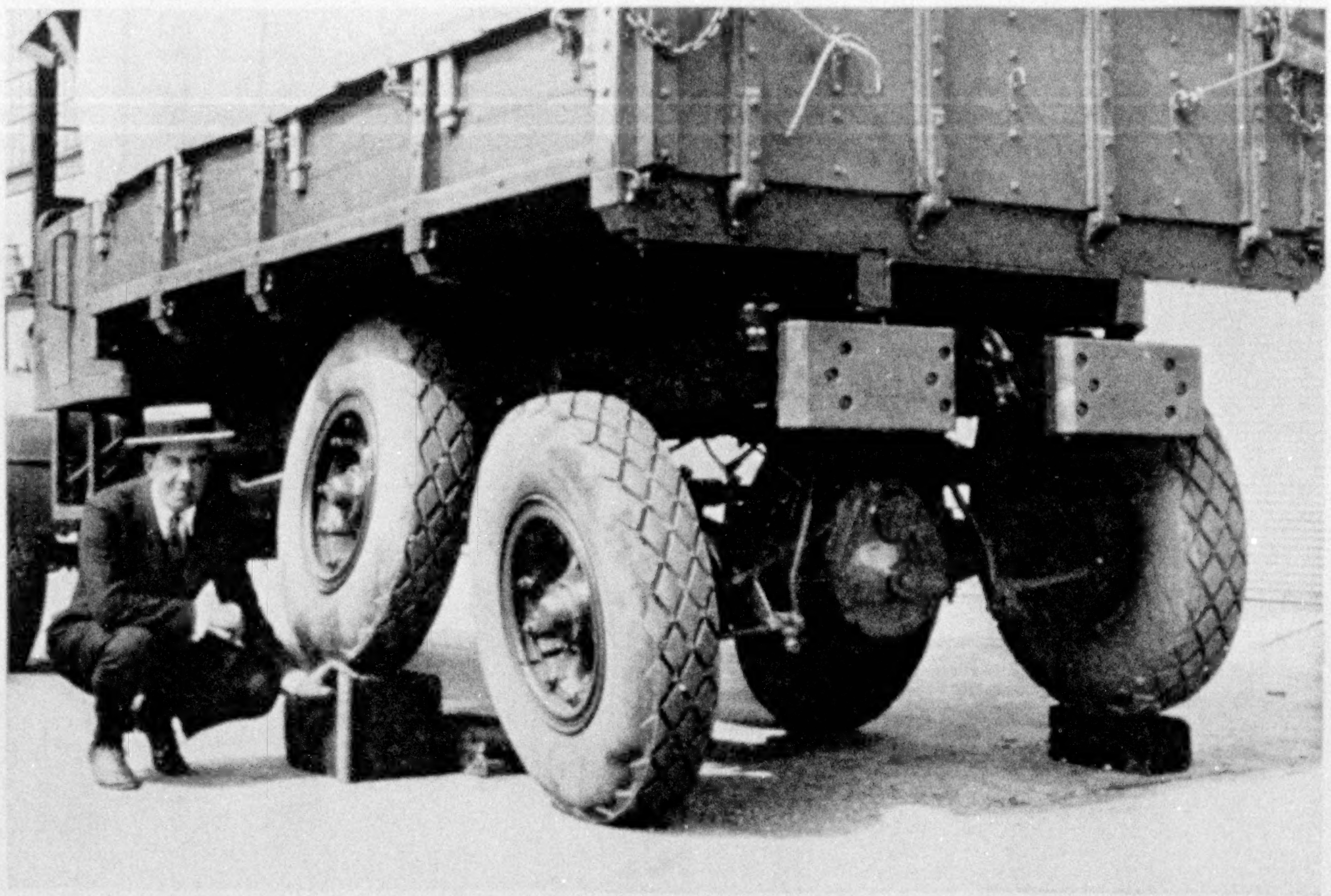
CINCINNATI RESULTS SHOW WHAT TRUCKS CAN DO

In Cincinnati motorized freight terminals have been established. In a single year they released 66,000 cars for main-line movement on the railroads, eliminated 300,000 switching cuts, advanced freight movement over 52 hours, and cut the labor cost in half through the elimination of rehandling.

One of the abuses of the motor truck is to put it on long hauls that parallel railway lines. Statistics definitely show that long-haul truck lines sooner or later go out of business, only to be succeeded by others which, in their turn, find the competition ruinous. But in the meantime, they have made uneconomic inroads into the earnings of the railroads and cut down the service rail lines can render to a fraction of its former efficiency.

One of the uneconomic situations which has developed in the past generation is strikingly illustrated between Dayton, Ohio, and Indianapolis, Indiana.

There used to be a good rail service between these two cities that yielded a reasonable profit to the railroads. Then there came into the field a new carrier—



Photograph by Clifton Adams

A NEW SIX-WHEEL TRUCK DESIGNED BY THE QUARTERMASTER'S DEPARTMENT, U. S. A., AT CAMP HOLABIRD

This picture shows the flexibility of the truck construction of the new six-wheel type the army is developing. The one-foot rule shows the height of the block on which the one wheel rests. The block on the opposite side is six inches high. The four-wheel rear construction shown here can be built for the Government at practically the same expense as the orthodox two-wheel single-axle construction.

an interurban traction line. It so ate into the business of the railroads that they were forced to curtail their service.

But still later the fine motor highway between Dayton and Indianapolis was opened up, and it, in turn, made heavy inroads upon the traction line.

Some day there will be a coördination of our transportation facilities that will adjust such conditions, making each an asset rather than a liability to the other. When railroad, traction and motor lines are correlated properly, each will add to the strength of the others and the public will be vastly the gainer.

The truck is fast eliminating the horse from the cities of the country. Between 1910 and 1920 the number of horses in New York decreased from 128,000 to 56,000; in Chicago, from 68,000 to 30,000; in Philadelphia, from 50,000 to 19,000; in Baltimore from 15,000 to 7,000; in Cleveland, from 16,000 to 4,000.

The Quartermaster's Department of the Army, at Camp Holabird, under the direction of Arthur W. Herrington, is developing two types of trucks that promise to revolutionize truck construction for heavy duty. One of these types has a four-wheel drive, with oversize pneumatic-tire equipment. This truck will go almost anywhere that caterpillar tractors can go, and some places that they cannot, in cross-country work and on wet clay roads; and on top of that, it will do anything that a regulation truck will do on good roads. As efficient as a caterpillar in bad going and as speedy as a regular truck on a good road surface, it can be built at a reasonable cost.

The other is a six-wheel truck capable of handling a 7½-ton load, with even less pressure per square inch of tire-road contact than the ordinary 3-ton solid-tire truck. The four rear wheels are assembled after the fashion of the ordinary railway-car truck, and are driven by a double differential from the propeller shaft.

Photograph by Paul Thompson

A FLEET OF TRUCKS ON THE COURTHOUSE PLAZA IN BALTIMORE EN ROUTE FROM DETROIT TO FRANCE

Both of these trucks are built up out of standard parts, and not only will they develop new fields for automotive transportation in time of peace, but they will also constitute the types of heavy-duty vehicles the Army will want in the unhappy event America ever has to unsheathe its sword again.

THE TRACTOR'S PART IN THE HORSELESS AGE

The farm naturally is the last stronghold of the horse. The natural inertia of the farmer has something to do with this. But more than that, the tractor that will serve him as well in its field as the motor car does in its sphere has not until now shown signs of appearing.

First of all, it must be a tractor that can utilize existing farm implements. An investment of $3,500,000,000 in horse-drawn equipment is too great to send to the scrap heap.

It must, therefore, be capable of operation by reins, just as if it were a team of horses. This gives freedom to the operator to attend the machinery being pulled, as well as to the tractor itself.

In the second place, it must be so designed that it can be used in cultivating row crops like corn; it must be able to straddle one or two rows and turn in a small radius at the end.

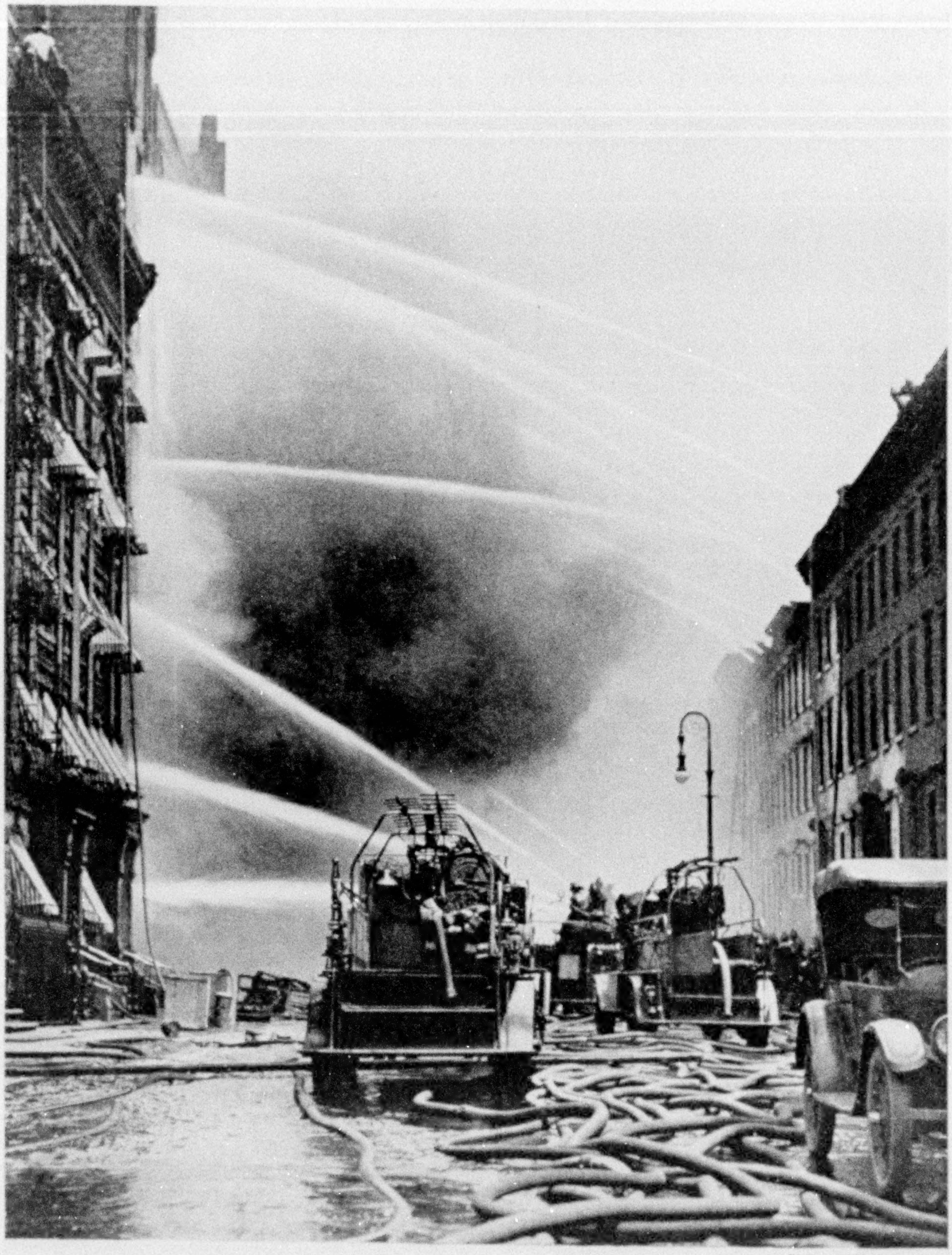
In the third place, it must be able to render efficient belt-power service, so that the farmer can hitch it to a wood saw, a threshing machine, and whatnot.

The fourth requirement is that it shall take the place of the horses on the road as well as in the field, so that it may be fully able to substitute the horse.

Happily, all these specifications have been, or are being, filled except the last. To make a wheel that is readily converted from one with a cleat-studded rim for field duty into one with a smooth rim for road work is a task that is engaging the attention of the best engineers. One manufacturer says he will pay $25,000 for the wheel that completely meets this need.

A NEW ECONOMIC TRANSFORMATION

With Canada announcing a half-billion-bushels wheat crop, with Siberia on the eve of bonanza cereal farming, with



© Paul Thompson

FIGHTING A CHEMICAL WAREHOUSE FIRE IN NEW YORK WITH MOTORIZED APPARATUS

The fine spectacle of dashing fire horses is rapidly disappearing. Many of the major cities have completely motorized their fire-fighting equipment. Not long ago the last of Chicago's horse-drawn fire apparatus was discarded, the occasion being made a ceremonial one. A box a short distance from the station was pulled to start the four horses on their last run; after they had left, the new motor equipment was driven in. The efficiency of fire apparatus involves speed and convenience in reaching a fire. Breakage due to rapid runs and the additional hazards of bad pavements and crowded streets result in the necessity for adequate repair departments. New York maintains well-equipped shops where not only worn and damaged apparatus is repaired, but new apparatus is given careful and practical tests before purchase.

Photograph by Paul Thompson

PUTTING A NEW MOTORIZED WATER-TOWER INTO ACTION IN NEW YORK

The most precious moments in combating a fire are those before the flames have had time to spread. The reduction of time in getting to the scene after the alarm reaches the engine-house, by the substitution of motorized for horse-drawn apparatus, has resulted in checking many a potential conflagration.

Argentina and Australia developing in rapid strides, the American farmer must become a more efficient producer to meet their competition, which has much more to do with the present low prices of farm commodities than most people realize.

In those countries cheap lands produce large holdings and vast fields, where production costs per bushel can be driven down by highly organized power farming.

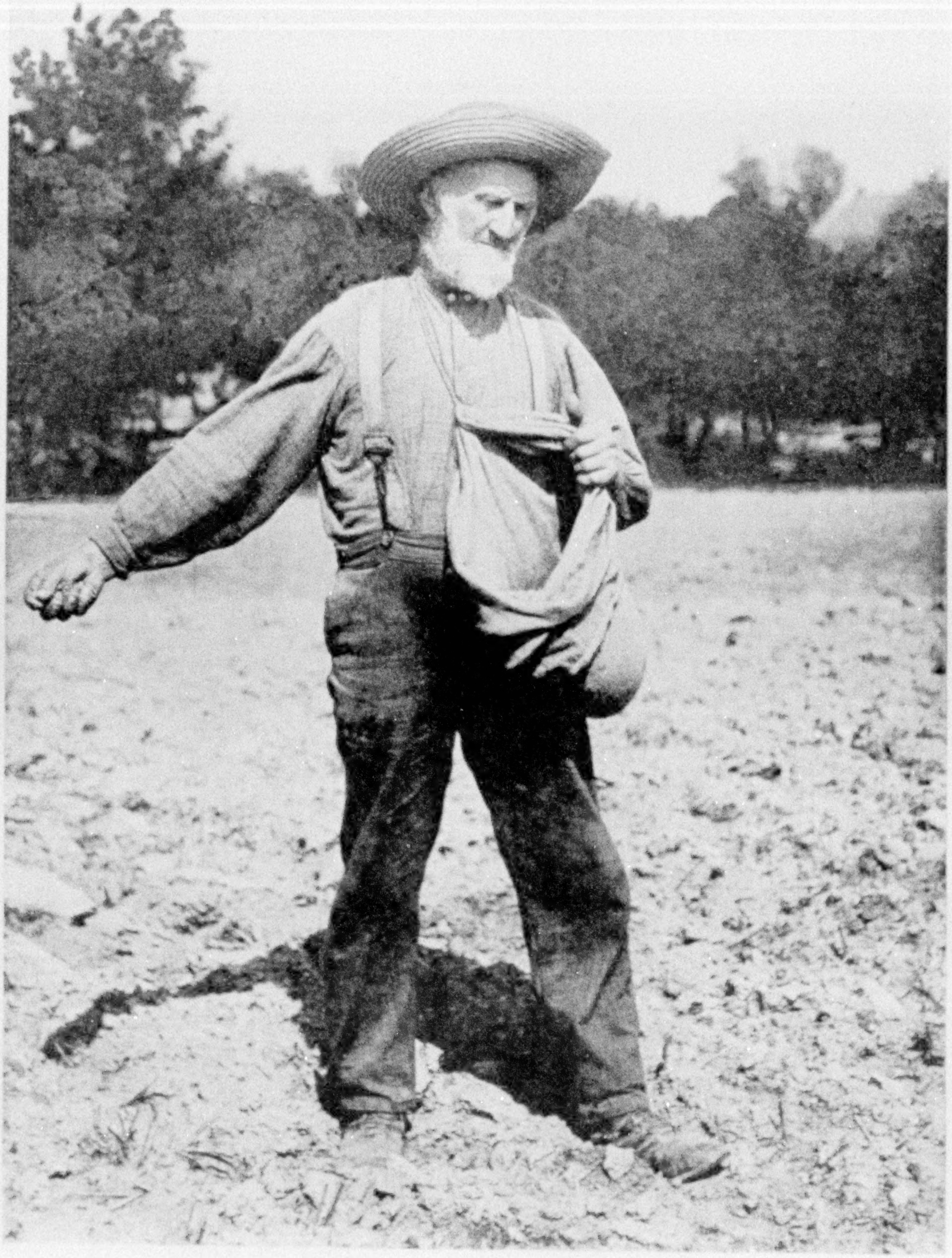
POWER FARMING AND PRODUCTION

Experience throughout the tractor farming belt shows that if the farmer values his labor at current rates, it costs less to sow and reap an acre of wheat with tractor-drawn equipment than with horse-drawn. Experiment-station records in our Western grain belt present striking illustrations of this. The reduction in labor costs goes down much faster than equipment and maintenance costs go up.

But that is only the beginning of the story. Power farming and horse cultivation of identical tracts in Kansas resulted in eleven years in the production of eight bushels of wheat on the power-farmed tract for every five on the horse-tilled land.

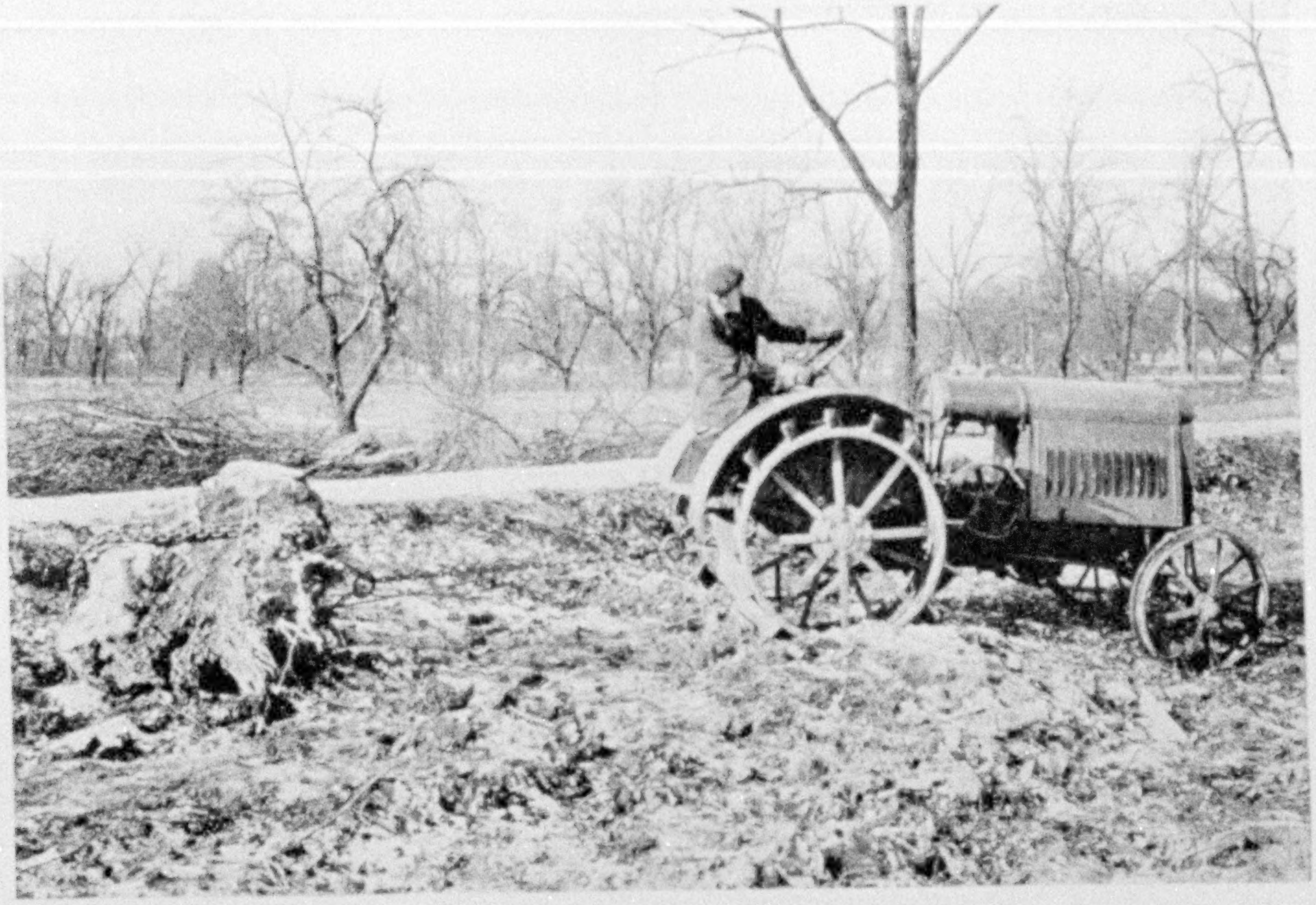
The secret of this success of the tractor over the horse was that, with the former, the land could be plowed seven inches deep in July, while with the latter, owing to the heat in midsummer, it had to be plowed five inches deep in September.

As the July-plowed soil contains one and a half times as much moisture as the



A REMINDER OF THE TIME WHEN GRAIN WAS SOWN BROADCAST

Handpower gave way before horsepower a generation ago; and now, in its turn, horsepower is facing a formidable rival in tractor power (see illustration, page 414).



DRAGGING OUT STUMPS IS ONE OF THE MANY JOBS ASSIGNED THE TRACTOR WHEN THE "BUSY SEASON" ON THE FARM IS PAST

CLEARING NEW GROUND WITH A TRACTOR

Five acres per day can be cleared with a thirty-horsepower tractor and a twenty-four-inch plow. The reader born on a farm will doubtless remember the time when the brush this machine plows under had to be grubbed out, piled and burned, and the ground "ripped" up with a "bull-tongue" shovel plow.

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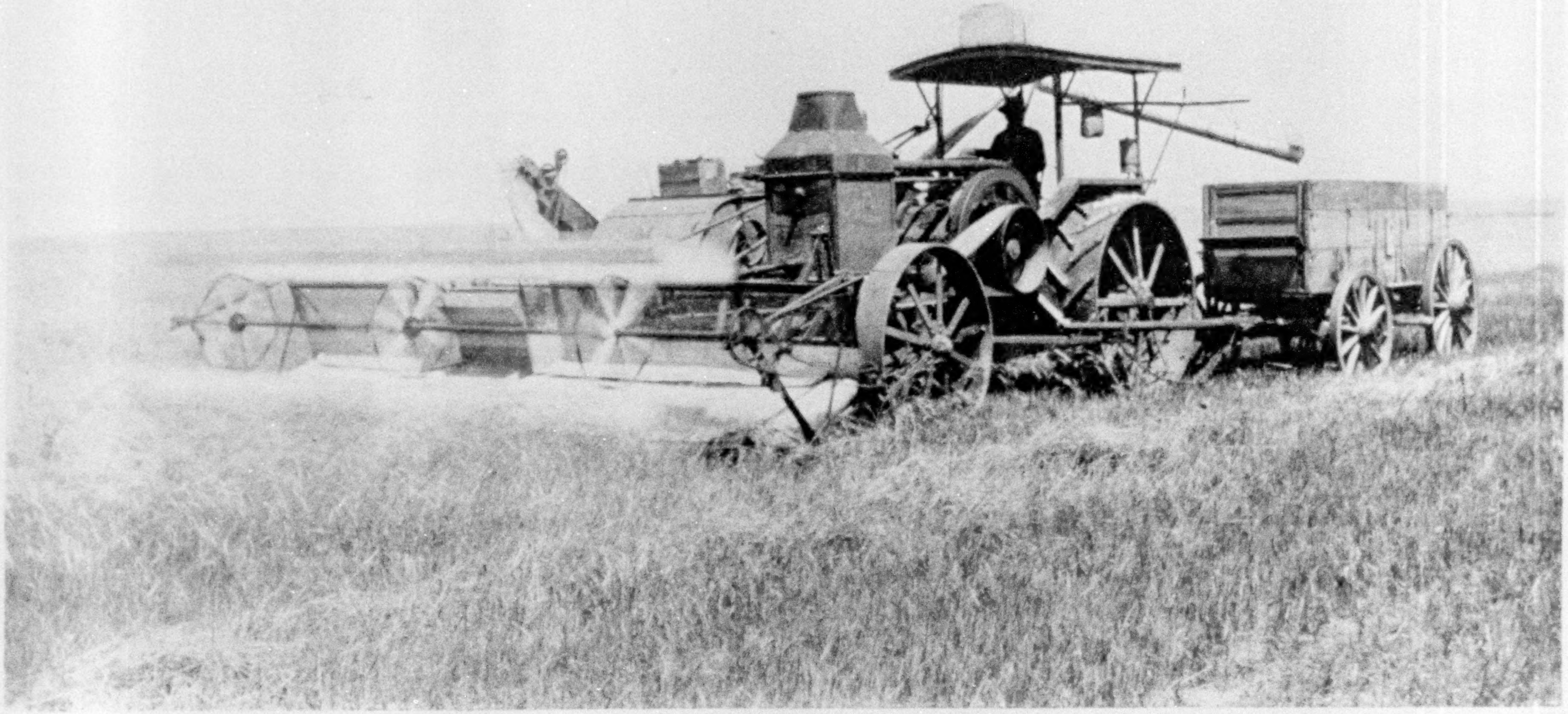
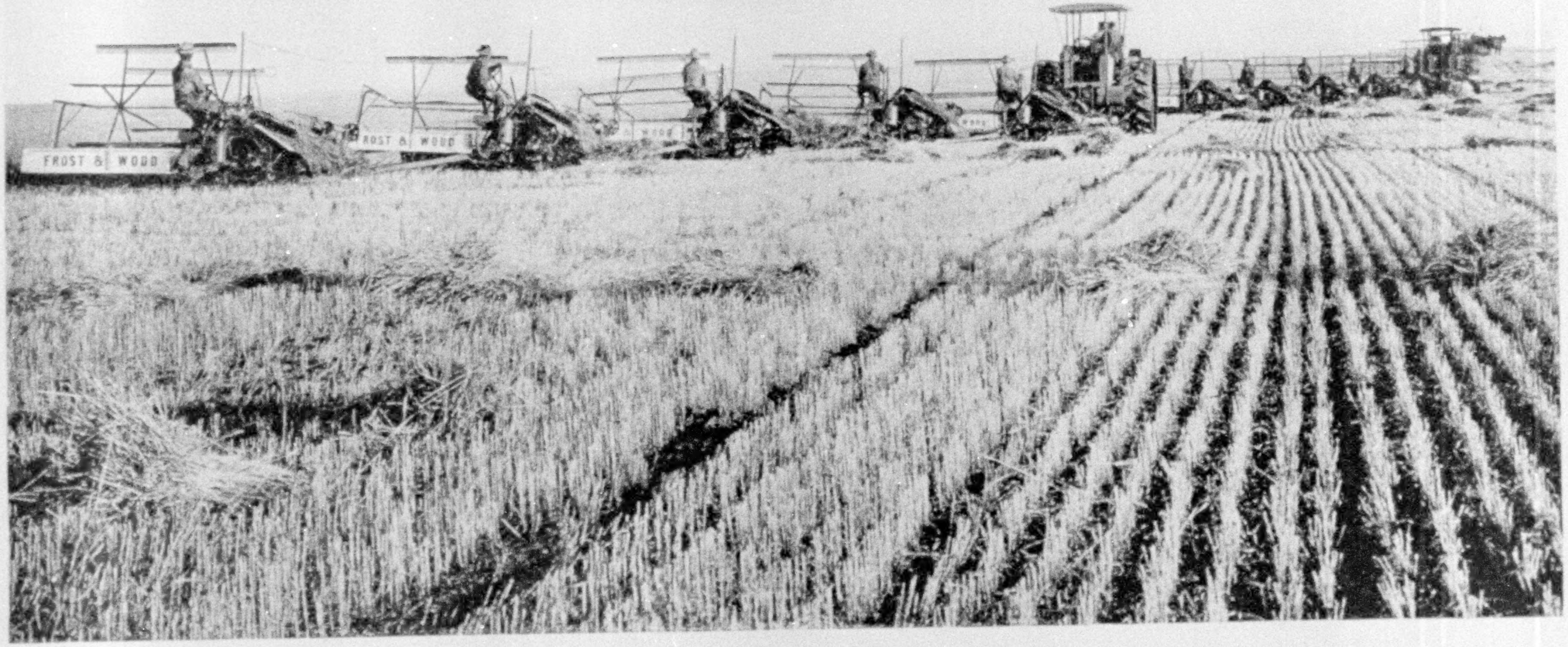


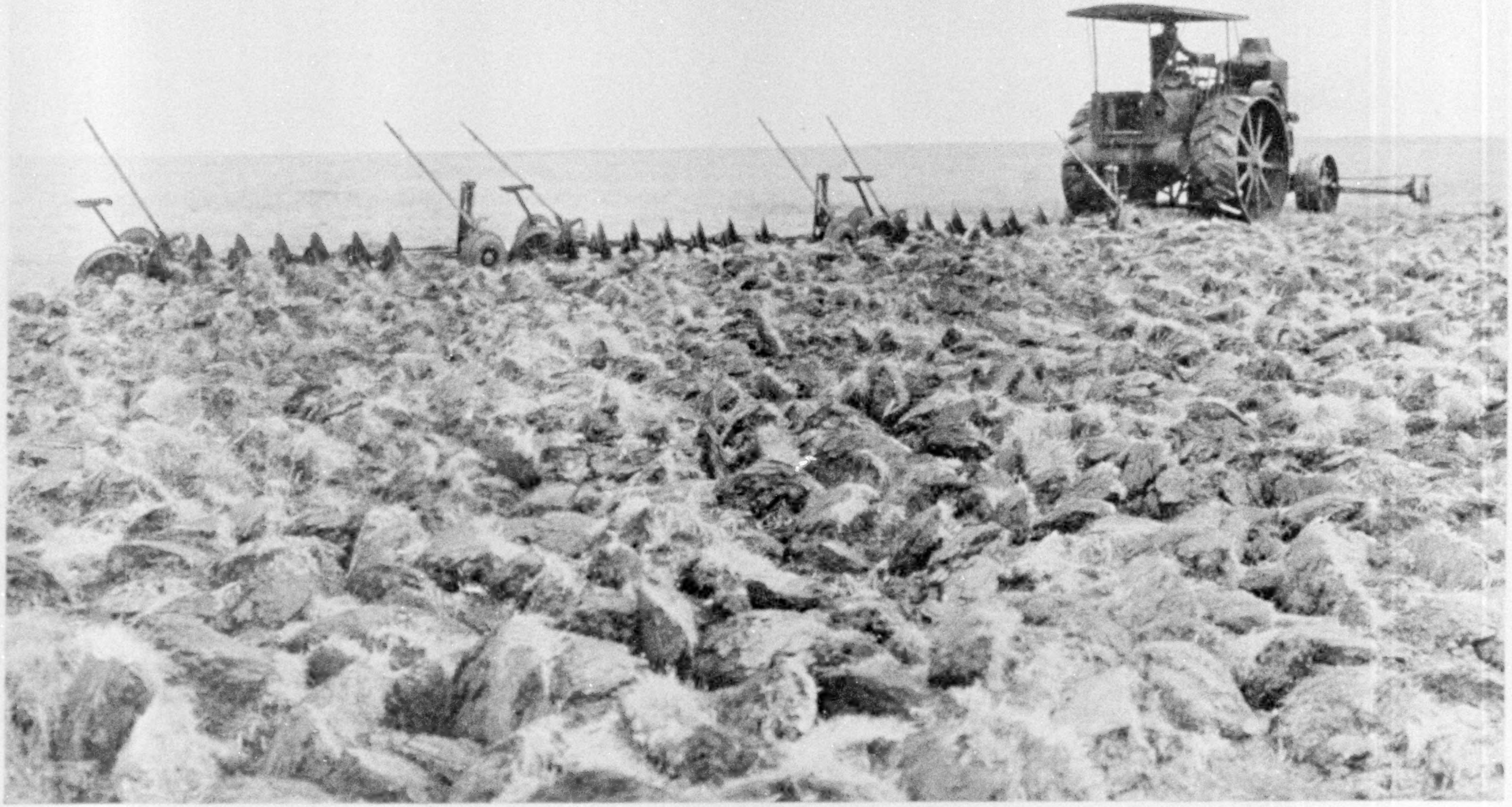
A "COMBINE" AT WORK ON A CANADIAN FARM

This machine cuts, threshes, and delivers to the wagon alongside more than 100 acres of wheat a day. Many elderly people can remember the grain-cradle and hand-flail era, when it would have required the labor of some three hundred men to do the same work in the same length of time, to say nothing of the twenty-eight horses required to haul in the crop. Even the binder and the threshing-machine would call for about sixty men and forty horses for cutting, hauling in, and threshing a hundred acres of wheat in a day.



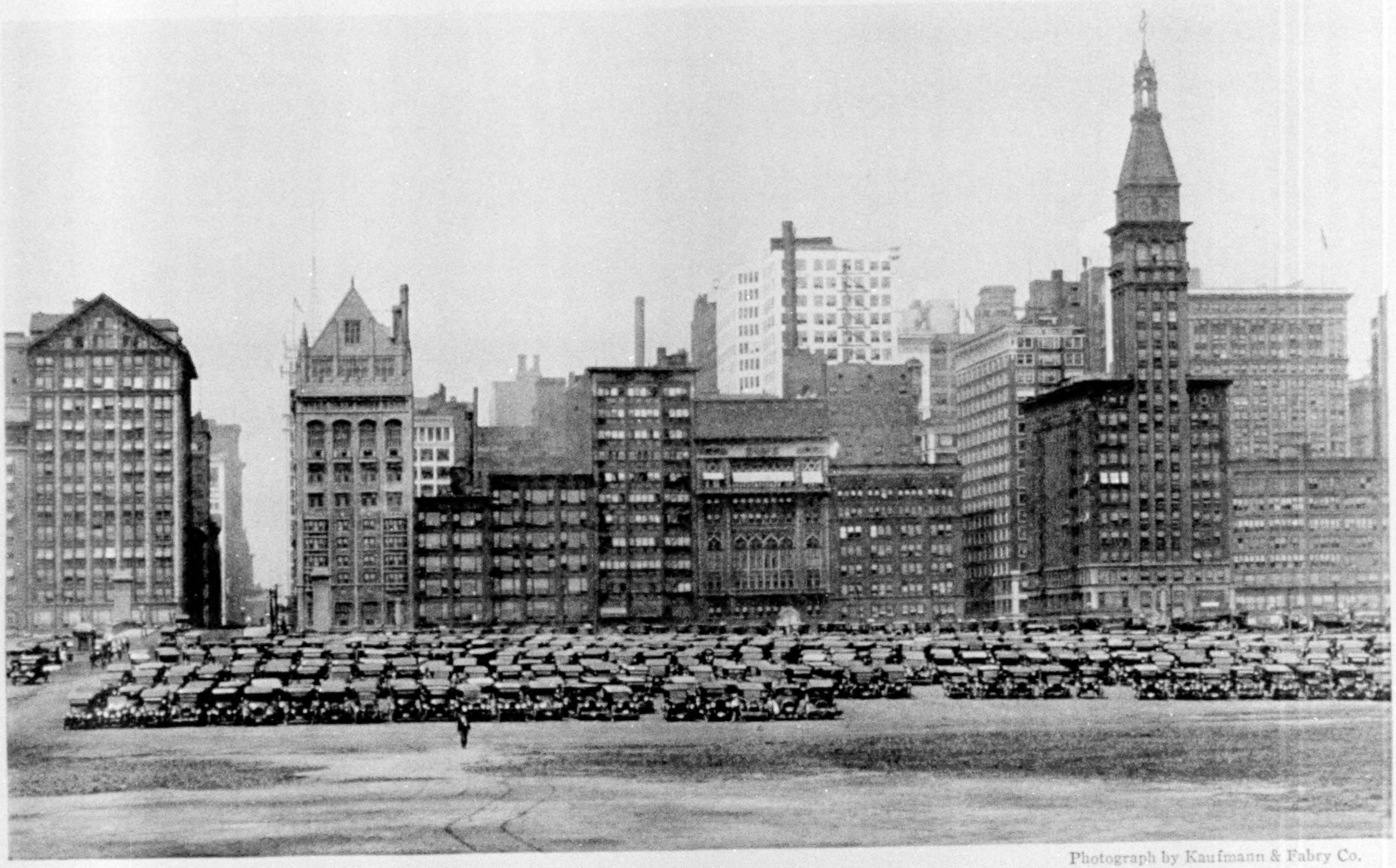
BONANZA FARMING IN CANADA

This picture of operations in a seven-thousand-acre Canadian wheat-field shows the character of the competition the American farmer must meet in the future. One tractor and six men do the work of twenty-eight horses and fourteen men, with horse-drawn binders. The high cost of labor will do more than any other agency to bring about lower production costs on the farm by necessitating an increased substitution of machines for hands.



DISK-PLOWING THE RICH PRAIRIE SOIL OF THE MIDDLE WEST

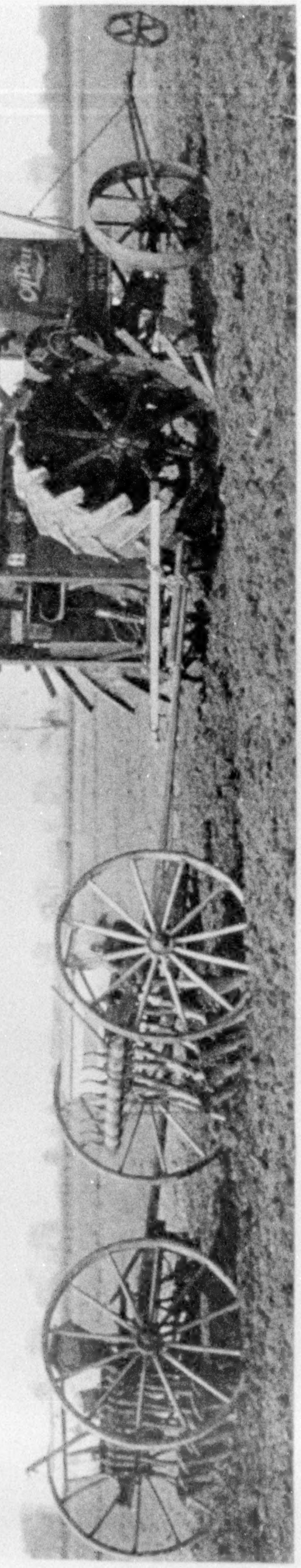
The thousands of quarter-section farmers do not make interest on their investment, much less a profit, with dollar wheat. The large tract, with power-farming methods, can show a profit, even at such a price.



Photograph by Kaufmann & Fabry Co.

PUBLIC PARKING SERVICE IN THE RECLAIMED GROUND ALONG MICHIGAN AVENUE, CHICAGO

The vast demand for parking space in Chicago is met by the establishment of a public outdoor garage, where cars may be checked for a nominal fee. The motorist gets a check, and the car is not released except upon its presentation.



TRACTOR-SEEDING ON AN UP-TO-DATE FARM

Contrast this picture with the one on page 408 and note the progress a single generation has wrought.

September-turned, and as deep plowing turns up more plant food than shallow, it is easy to account for the difference in yield.

These examples of lowered per-acre costs for cultivation through the elimination of high-priced labor, and increased per-acre yield through better methods of cultivation might be multiplied indefinitely.

THE DAWN OF A NEW ERA

We stand on the threshold of another transformation in farm life, as significant and as far-reaching as that which took place when the farmer laid away his scythe, grain cradle, and flail for the mower, the binder, and the threshing machine. By substituting machines for hired hands, the farmer will lighten his heaviest load—high labor costs.

When the versatile utility tractors that are now ready to come on the market make their bows, the farmer will settle the labor question as he settled it with his binder and mower.

He will discover that he can so decrease his labor cost and increase his acre yield as practically to make two dollars grow where one grew before.

The substitution of power for horses will mean millions of people released from agriculture for industry, as was the case when the farmer substituted horses for men.

With more urban mouths to feed and backs to clothe, and fewer rural ones to provide for, a new day will dawn when the efficiency of the factory will come to the farm, and then the American farmer can do what the American automobile maker has done—meet the competition of the world and still make money.

And when the noontide of that day is reached, the great triumvirate — the passenger car, the freight truck, and the farm tractor—are destined to write a record of service to America that will stamp the automobile engineer as one of the foremost contributors to human welfare in all the history of mankind.

THE EMPIRE OF THE RISEN SUN

BY WILLIAM ELLIOT GRIFFIS

The appalling calamity which befell the Japanese in the destruction by earthquake, fire, tidal wave, and typhoon of the capital city, Tokyo, and its seaport, Yokohama, as well as other centers of population, on September 1, has not daunted this industrious and resourceful people. The same qualities and characteristics which Dr. Griffis, in the following article, sets forth as responsible for the rise and development of the Japanese will enable them to build a new and greater capital upon the ruins of the old. The fortitude of the island kingdom of the East in the face of unprecedented disaster has commanded the admiration of the entire Western World.—THE EDITOR.

JAPAN'S SUN has risen and her "century aloe flowers to-day." Nevertheless, while to the world, almost dazzling as has been her uprising, as of a new sun to the zenith and to world power, the causes have been psychological rather than material and from within more than from without, and there are men of centuries gone who deserve equal honor with those of our time.

Two documents lying on my table tell a story of what once seemed in earth's garden a plant not only "born to blush unseen," but even to die without flowering; yet within the lifetime of one man Japan has become the wonder of the world.

The official Résumé Statistique de l'Empire du Japon, 36ieme Année—that is, in the 11th year of the era of Taisho (Great Righteousness)—in two hundred pages of close print, shows Dai Nippon an empire of sixty-five millions of souls, alert and advancing in every line of human endeavor. By contrast with 1870, the story of prosperity and national expansion reads like a fairy tale. One does not need a Gladstone to "make figures eloquent"; eloquence is here.

The other document is the report of the Fukui Silk Textile Association. When I first saw this interior city in a feudal fief, it had not a single chimney. It is now the center of the habutai (featherwoof) silk production.

In place of castle moats, privileged samurai wearing two swords and the despised merchant having little or no social standing, Fukui is now a typical industrial city, with electric lights, steam power, and modern appliances in factory and home, and her young men are ambitious to make fortunes in industry.

Osaka, once chimneyless and a wilderness of one-story houses, is a forest of smokestacks, with mills, imposing steel-jointed business structures, shipyards, foundries, and factories.

With population more than doubled, with wealth increased twenty-fold, and transformed from an almost forgotten hermit nation into a world power, a leader in industry and commerce, with an ambition to be second to none in capturing the markets of the world, it is well for us to look into the causes of Japan's evolution and triumph.

Yet in accounting for such outflowering within the last half century, "as if a lily blooming in the midst of the salt ocean," there are those who have all along refused to be surprised. They know that the lotus does not grow in brine, but that even the pond lily has unseen roots in the mire far down below.

In mythology, Minerva leaps full-armed and radiant from the brain of Jupiter, but in actual history, the Buddhist philosophy of Ingwa (Cause and Effect) is sound.

NEW PHILOSOPHY REPLACED CONFUCIAN CULT

For Japan's development, there are reasons both internal and external. First and greatest of all was the new mind created long ago by the Oyoméi (intuitional-pragmatic) philosophy, which threw the reactionary Confucian cult into comparative shadow.

In this mental discipline it should be noted that every one, without exception,

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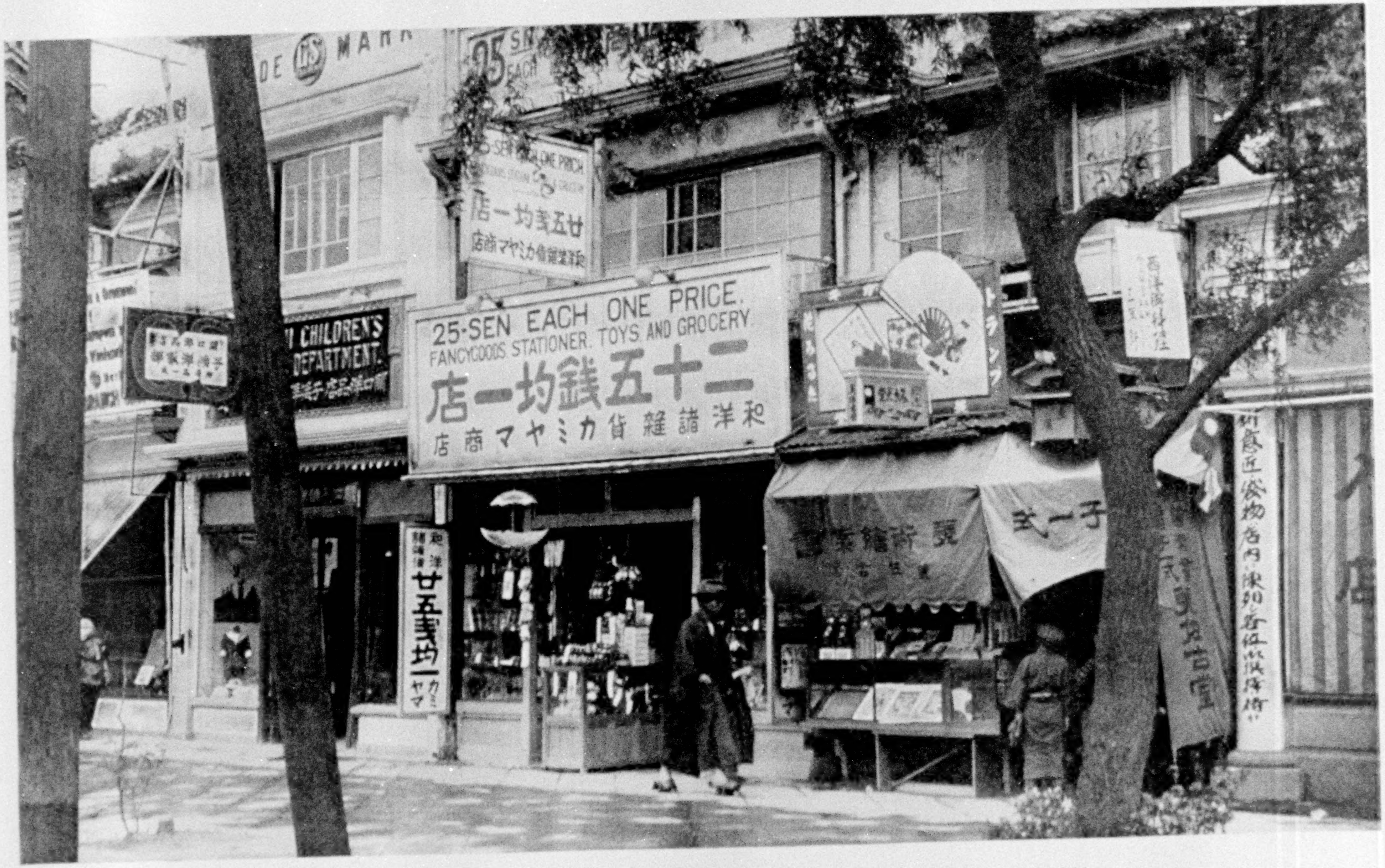
25-SEN EACH ONE PRICE.
FANCYGOODS STATIONER. TOYS AND GROCERY
二十五銭均一店
和洋諸雑貨カミヤマ商店
CHILDREN'S DEPARTMENT.
廿五銭均一
廿五銭均一カミヤマ

TWENTY-FIVE-SEN STORE IN YOKOHAMA: ONE PRICE BUT TWO LANGUAGES

Japanese stores are rapidly getting away from the bargaining methods common in the Orient and in several cities there are one-price guilds which maintain a standard charge for goods. A 25-sen store, corresponding to a sixpenny bazaar, deals in a wide variety of articles worth about 12 cents in American money.

of "the fifty-five creators" of the New Japan were trained, and some proved to be past masters. Without this element, the Japan we now know would not, could not, have been. Introduced from China, in the seventeenth century, the philosophy of Wang Yang-ming (Oyomei in Japanese) was developed and taught by book and expounders in fifty different centers.

Two hundred and fifty years of peace sufficed for the accumulation of the nation's potencies in preparation for outburst, when the opportunity should come.

SEEDS OF DUTCH CULTURE SOWN EVERYWHERE

During all this period there was unbroken contact with Europe through the Dutch at Nagasaki. Even the Portuguese and Spanish contacts of seventy years, with merchants, military men, and engineers, had left their mark on the Japanese language, architecture, music, military science, and dietetics. Then, from the Dutch, with their mechanics, physicians, language, books, apparatus, and hospitals, such wonderful results were wrought in art, science, invention and trade, in ideas and commodities, that Swift, through his knowledge of Holland, was able to pen his extravaganza, "Gulliver's Travels."

When, in January, 1871, the writer began his work in the Imperial University, in which were students from all the provinces and from every one of the 280 feudal factions of the empire, he secured scores of autobiographies. By means of these and later by travel and research, he found that Dutch culture had been like seed sown everywhere.

A thousand spots of light foretold the coming dawn of a long bright day. Hundreds of native physicians read the noble Dutch language and in a measure practiced European medicine. At Nagasaki, Dr. Pompe van Merdervoort had established a hospital and trained physicians, while Dutch mechanics, with the aid of Japanese workmen, had built a steam yacht.

On the streets and in the drug shops, I noted (printed in Dutch) nostrums and patent medicines from Rotterdam, and (by logical connection?) in the cemeteries found epitaphs in Dutch. Being a teacher of chemistry, I recognized, for example, in "raude," laudanum (no *l* in Japanese), one of a long list of drugs and chemical substances imported in their popular form from Europe as old staples.

In a word, Japan was as a rich clover field already pollenized from the Occident. Like a steady line of bees, the Dutch ships had been bringing the vitalizing influences for more than two centuries. Yet to the Japanese, the modern revelations, on a large scale, were the "black ships" of the American whalers that gathered in their waters. What the islanders learned both from honestly shipwrecked sailors and from the voluntary waifs (chiefly mutineers) quickened the national temperament.

Ranald MacDonald, from Sag Harbor, New York, in 1848, had himself cast ashore and was honored as a teacher at Nagasaki. In his hotellike prison, he trained a dozen interpreters and had them well prepared in good time for Perry's advent. He was aided by Nakahama Manjiro, a Japanese educated at New Bedford, Massachusetts, who had been picked up at sea as a waif by an American captain.

AMERICANS BROUGHT WESTERN IDEAS AND INVENTIONS

President Fillmore's fleet, which was ordered to sail for the East in 1852, on the same day that Japan's greatest emperor, Mutsuhito, was born, consisted largely of store ships, which were loaded with American inventions and products.

After Commodore Perry had completed his treaty-making, there was held, in 1854, on the strand at Yokohama, Japan's first industrial exposition. In 1872 I saw the more ornamental presents in the storehouse at Shizuoka, the place of the last shogun's banishment.

The things of use, in agriculture and the arts, had already been widely distributed and copied, especially in that new part of the empire called the Hokkaido (Yezo), which throughout bears a very American aspect; and the reason of this is clear. A commission of scientific and practical men, sent out from Washington, D. C., was active in the island during the decade between 1870 and 1880.

Even more impressive to the student of Japan's evolution were the personnel and equipment of at least five of the first American missionaries. Three, besides

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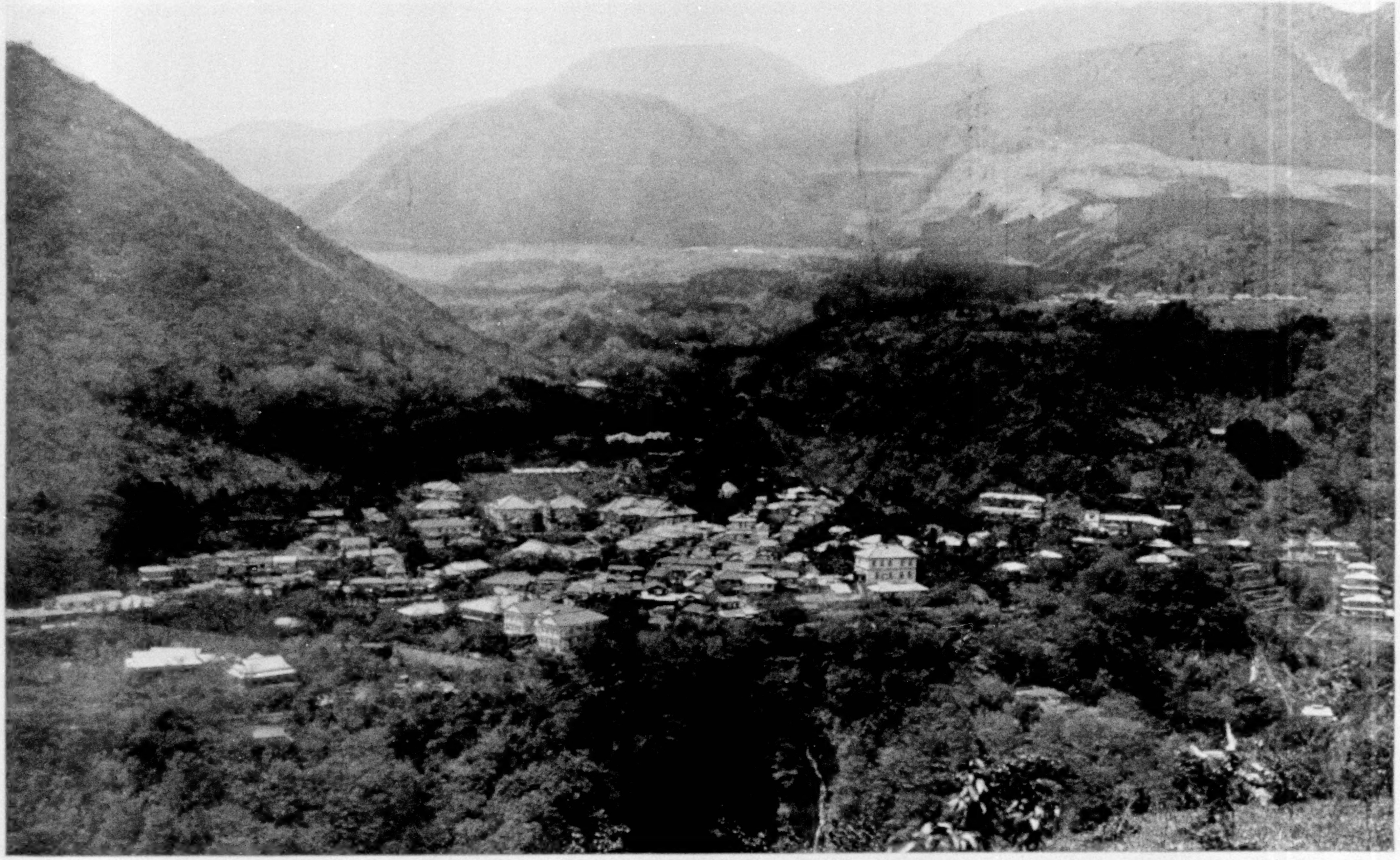

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BIRD'S-EYE VIEW OF MIYANOSHITA, JAPAN

This Japanese town, which was noted throughout the Hakoné district because of its excellent hotel accommodations, fresh air, and beautiful scenery, lay in a wide, level tract in the valley of the Haya-kawa, 1,223 feet above sea-level. A part of this city was thrown down a precipice during the great earthquake. Many of the members of the diplomatic corps and foreign residents in Japan were at summer resorts in the Hakoné district at the time of the Tokyo-Yokohama disaster.

being mature in experience, had been long before in China, or were men of science and technical ability. Dr. J. C. Hepburn opened a hospital and dispensary and trained the first surgeons and physicians, and he and S. R. Brown, as Pontifices Maximi, built the bridges spanning the gulf between the two languages, with their grammars and dictionaries. They also trained the intellectuals, and introduced likewise photography and the finer arts.

The third, G. F. Verbeck, was a marine engineer and master of seven or eight languages. For years, when the Gospel was still unpalatable, he taught the Japanese everything they wished to know. Then he organized their university, taught them the spirit of occidental law and custom, explained the freedom of the press and how church trustees held property. He also proposed the great embassy of 1872-4 around the world to study the details of Western civilization, half the personnel being chosen from his pupils.

Moreover, even from 1860 to 1875, scores of American schoolbooks had been translated into Japanese.

THE YOUTHFUL NATION SEIZED UPON NEW THINGS

Back of all was the nation's youth, with its vigor, its innate capacity to select, adopt, adapt, and become adepts. Both geologically and in human history, Japan is the youngest country in Asia.

From 1859 to 1868 not a few foreign helpers on the soil gave their time and talents to aid Japan; but after 1870 and until 1900 and later, Argonauts from the West came in fleets to cover Japan with a golden fleece. No fewer than five thousand *yatoi* (salaried foreigners), experts in every line and field of human endeavor, were called out and employed. From $28,000 to $1,000 were the salaries paid to these teachers, advisers, and technicians.

These men started the first railways, telegraphs, lighthouses, navy yards, foundries, mercantile projects, mechanical inventions, appliances, and agencies. I had the honor of starting the first school for manual training and technical art and science.

Yet the Japanese already had the capacity and ambition. We aliens were only the guides, helpers, and servants. An American missionary, Jonathan Goble, invented the jinrikisha, that has rolled round the world. Nevertheless, let me repeat it, we yatoi (I being the first to arrive of those called out under the Imperial Charter Oath of 1868) did but teach the rudiments and point the way. It was the Japanese who made the New Japan.

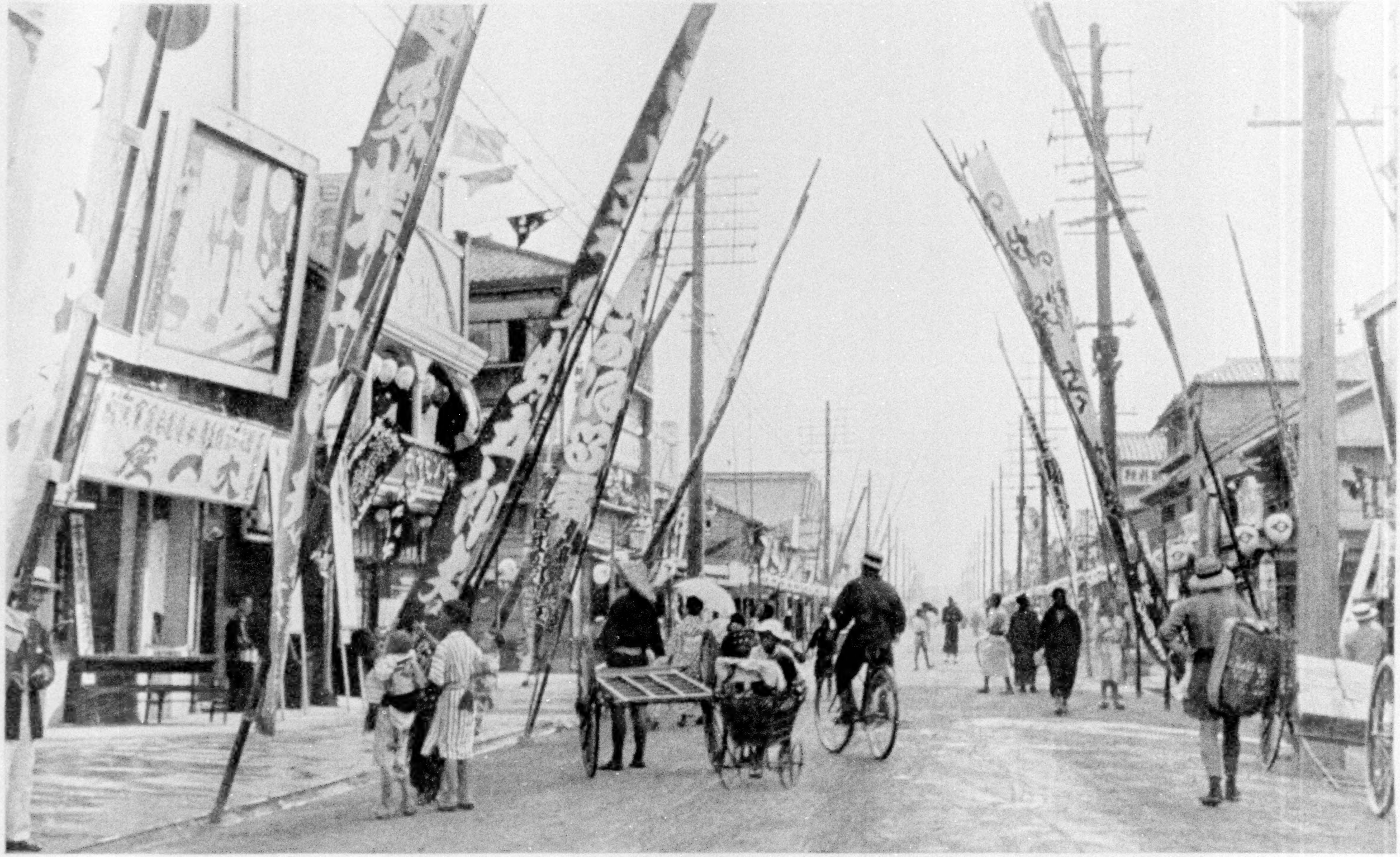
When feudalism had been abolished, in 1871, and the once-despised merchant was given honor and opportunity, he unfolded the pinions of a towering ambition and looked abroad to capture the markets of Asia. It was "like giving wings to a tiger."

At a secret conclave in Tokyo, in 1870, of the leaders of the Revolution of 1868—unchronicled in history or official documents, but reported to me by Dr. Verbeck, who was present as umpire—the real problem, long debated, was this: Shall Japan be a nation of samurai and soldiers, or of merchants and industrials, and, in the main, the men of modern mind? Okubo, Okuma, and Shibusawa gave their lives to the uplift of the once-submerged class, now on the crest of the wave—the merchant and manufacturer.

Yet national defense was not forgotten. As early as 1860, young men had been sent to Holland for naval education; but it was under British officers that the imperial navy was reconstructed, while French first, and then Germans, recreated the military system. (Admiral Togo was for twelve years under British naval instruction.) To Americans was given the task of national education, methods of finance being borrowed from Belgium.

JAPAN'S FOUR GREAT MEN OF THE RECONSTRUCTION ERA

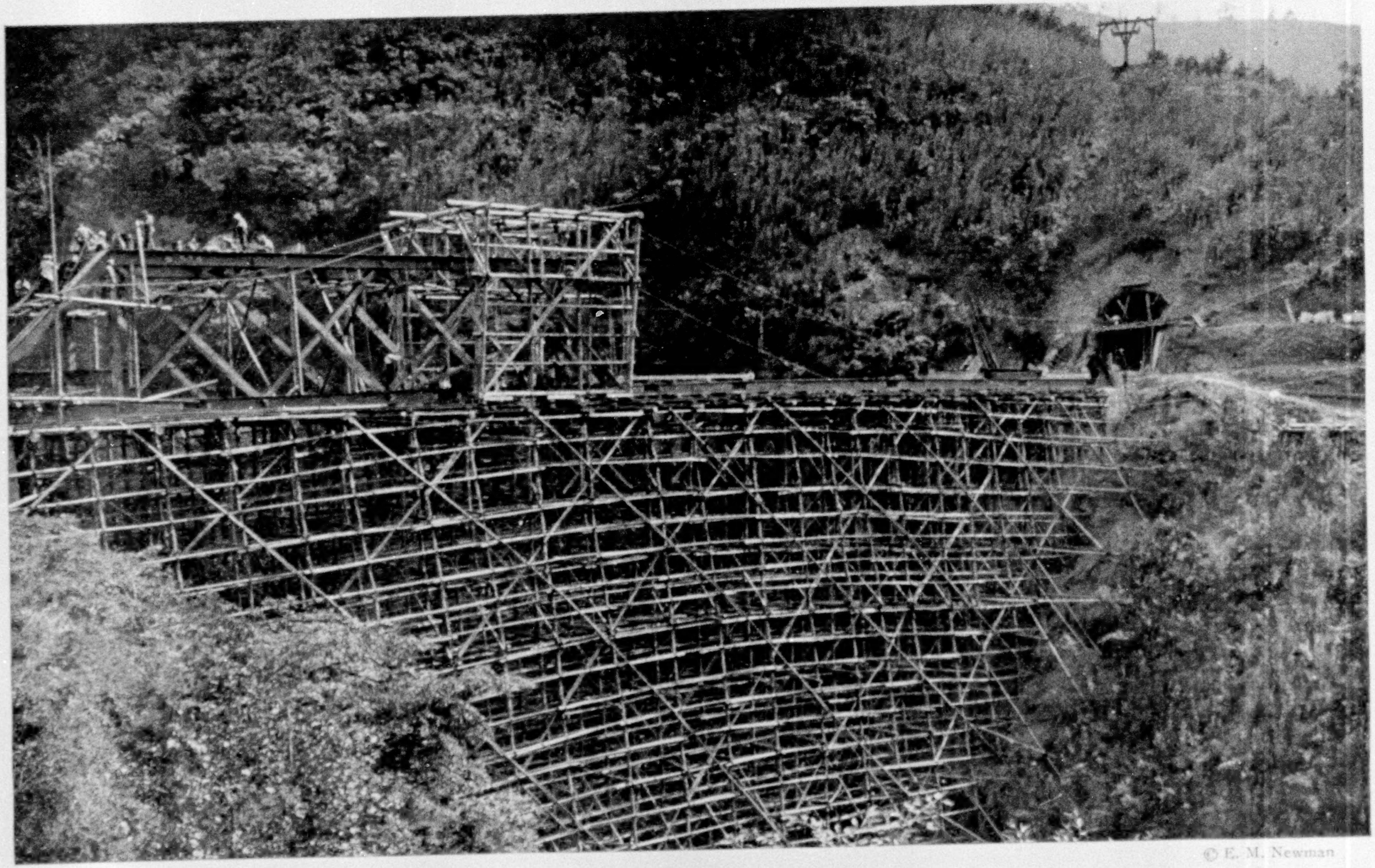
Of the four greatest men of 1868 and the reconstruction era, from 1868 to 1900, Okubo was the master spirit. It was he who had the capital changed from Kyoto to Tokyo and the Mikado brought down from the purple clouds of mystery and pseudo-deity to be a human ruler. Okubo infused into the Japanese the spirit of conquest of the world's respect by means of peace rather than by war. He was the brain and pen of what was not only Restoration but Revolution, and his



Photograph by C. H. Kragh

A THEATER STREET IN YOKOHAMA

Both the theater and racing have been popular amusements in this, one of the oldest and largest trading ports of Japan. It was opened to the world in 1859 by Commodore Perry. At that time it was only a fishing village with 87 dwellings.



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REPLACING A JAPANESE BAMBOO RAILROAD BRIDGE WITH A STEEL STRUCTURE

Although the island kingdom of Asia now has 7,000 miles of railways, the first line, 18 miles long, from Tokyo to Yokohama, was built only 51 years ago. One of the greatest engineering feats of modern times is the tunneling of the Moji-Shimonoseki Strait, separating the island of Kyushu from the main island of Honshu. The work was begun in 1920 and will be completed in 1928. The tunnel will be seven miles long, one mile of which will be completely under the sea.

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Photograph by Mrs. Jane Watts Fisher

BUYING POTATOES IN MIYAJIMA

The island of Miyajima, in the Inland Sea, is one of the most beautiful in Japan and also one of the holiest of the many holy islands in the Japanese Archipelago. It is dedicated to three Shinto goddesses, daughters of Susa-no-O, the Sea King. Human beings are forbidden either to be born or to die within its sacred precincts. The island's temple and its *torii* are famous in Japanese art.

son, Baron Makino, was heard from at Versailles.

Kido was the constructive statesman, with original ideas of which Ito was the executive, the motto of the latter being "Get it done and let them growl."

Iwakura, of immemorial noble lineage, was the link between the emperor and the high-souled parvenus, who did with the throne and court pretty much what they pleased, and in time changed theocratic despotism into constitutional monarchy.

FRIEND OF MERCHANT CLASS FACED ASSASSINATION

When the embassy returned from its world tour in 1874, there was a terrific struggle in the cabinet. It was to decide that Japan's path of progress was to be in the line of industrial enterprise rather than through war or territorial conquest. Okubo and the men of peace and development through industry won.

Hardly less of a revolution than that led by the four great men already named was that in finance and in education. We all expected Shibusawa would be assassinated (as a majority of the greater leaders were) when he pronounced in favor of modern bookkeeping and dedicated his life to elevating the once social outcast, the merchant. He cleared the way for Matsukata, who secured the adoption of the gold standard, even when Great China issued no coins valuable enough to be worth counterfeiting. This enabled Japan to gain and hold credit in the world's finance.

Tanaka, backed by Kuroda, fought to a finish the fight for the equality of female education in the scheme for national elementary instruction, when, in 1872, he called Miss Margaret Clark Griffis to begin the first school for girls.

Only the learned, in 1870, could by ear or eye read anything higher than shop accounts or tawdry fiction. All erudition was in the hieroglyphics of China.

READING DURING A LULL IN HIS TRADE

After a long sleep of centuries, young Japan is now wide awake, and no other country can boast such rapid strides in so many directions. Adopting quickly the forces of Western civilization, its people set themselves the task of modernizing their country in one generation, with such success as to astonish the world.

It was said by aliens first tackling the Japanese script and style of speech that there were seven distinct languages in one. At times Japanese gentlemen in conversation seemed to have graduated from an old-time school for the deaf, for they used their fingers and the palms of their hands most industriously to show just what ideographs they were using or the meaning they wished to convey.

A reform in this direction meant the uplift of humanity and the manifold increase of the nation's resources through productive individual ability. To my mind, these facts explain the national renaissance better than official statistics, imposing as these figures of millions are, or even the present-day reports of trained alien journalists.

Briefly stated, Japan is likely to keep up with her competitors in the race because of her previous preparation, and, now that she has accepted the proposals of the Washington Conference, she is likely to gain her "second wind."

"Education is the basis of all progress," became the motto of the nation fifty years ago. With the old Chinese characters, where a single sound might have, in writing, more than 200 different meanings, we can see the necessity of the finger-play referred to.

SETTING RICE

Nearly one-fifth of the farm land of Japan is devoted to growing rice. The area under rice has increased 80 per cent in the last 35 years, and is believed by some authorities to have reached its maximum. Irrigation is universal in the cultivation of paddy fields, and farming communities frequently combine to install a pumping plant. The rice harvest usually takes place in October. This grain, besides being the staple food, is the basis of *sake,* chief alcoholic beverage of the Japanese.

The new education uplifted a whole nation. Almost every village and hamlet pulses with new life. The victories, both over China and Russia and in the world's markets, were won first in Japan's public schools. In 1920 these numbered 25,644, with 178,450 teachers and 8,362,992 pupils—an almost unparalleled record, even in the Occident.

In all this there is a living parable. In Old Japan, man was too much like a beast, while the beast was too much like a man. Herein are the patent facts. For ages, and even until to-day, Japan has suffered from too much hand labor. She needs more live animals at the plow and in the fields, the streets and the mills, while she needs to uplift her men and women.

The common term, or numeral, in the old language for the laborer was the same as that for beasts of burden. Buddhism inculcated exceeding kindness to animals, but hardly, in proportion at

Photograph by A. Nielen

CUSTOMARY TRANSPORT IN RURAL JAPAN

Such conveyances are drawn by men, rather than horses. The Japanese horse is not used to any great extent for transportation purposes. In agriculture they are now used more than cattle, but live stock of any kind is scarce on the average Japanese farm (see also text, page 427).

least, to men. Japan taught us to rear monuments in honor of steeds slain in war, but it was Christianity that insisted upon more care of men. No such thing as a public hospital, in the modern sense, existed in Old Japan.

"WHAT WILL THE GRAVEYARD SAY?" IS THE NATIVE'S QUERY

Of Buddhism's indoctrination of a whole nation, one meets with noble and pathetic, comical and ludicrous examples every day. Men, while drawing or pushing carts—the work which horses ought to do—will, even with every muscle strained, turn several feet out of their way in order to save a mangy dog or chicken, big or little. Devoutly they abstain from crushing out the life of a living creature, through whose body the soul of some ancestor may be transmigrating.

Many a theme of grave debate and high diplomatic significance is powerfully influenced by the fear of ghosts. Unconsciously, the native asks, "What will the graveyard say?"

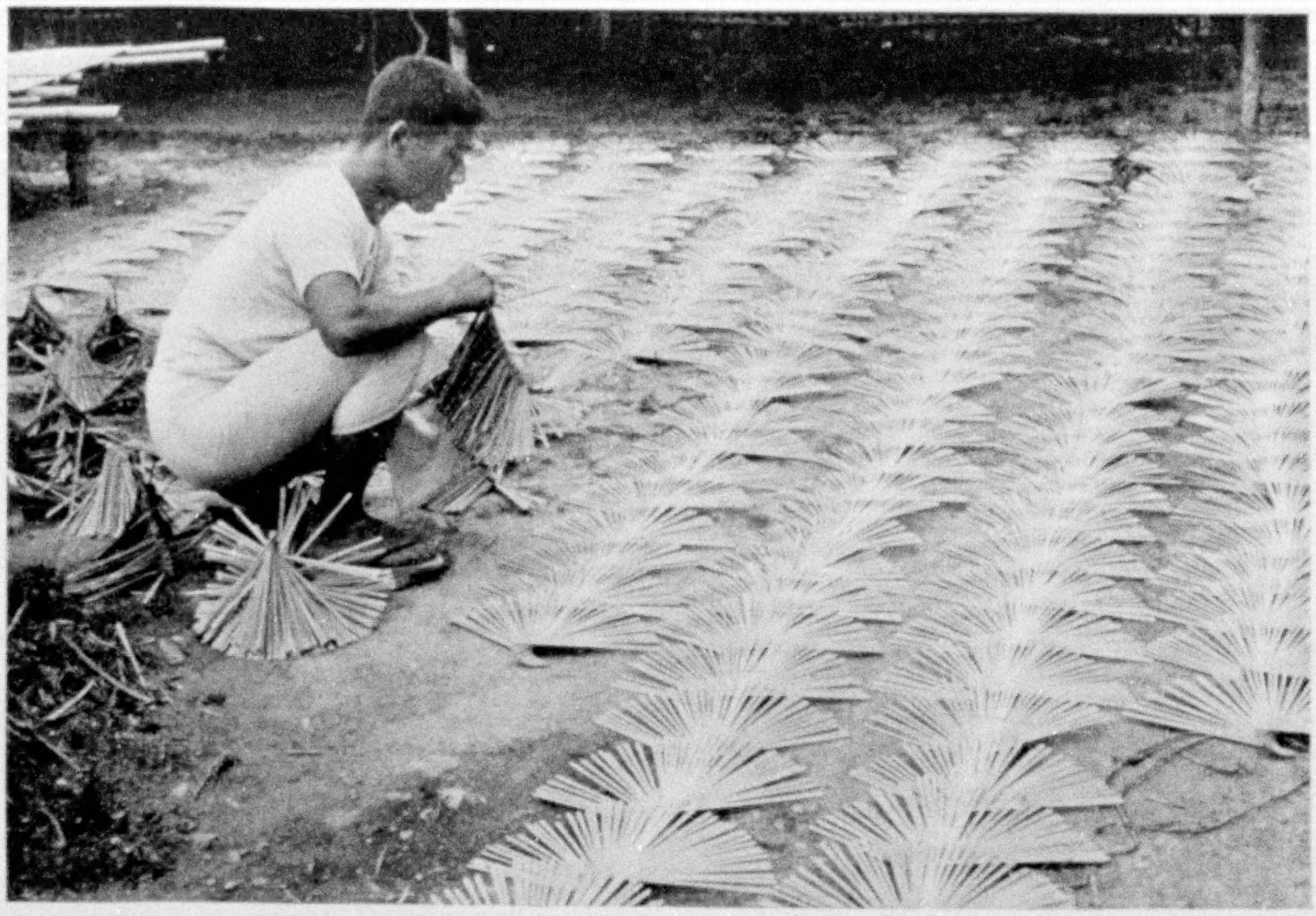
But why should Buddhism of itself care so much for "red earth" (the human body), when this is only one link in the endless chain of evolution up or down? Buddhism knows no such thing as an individual human soul, or a self-conscious, indestructible human spirit, but only each human being as the end of a long line of evolution through *ingwa* (cause and effect), with no God or Creator at either end of the line, except, possibly, an abstraction of force.

Why, therefore, should man more than brutes be cared for?

Such is the inquiry that springs in the brain of one born and reared in the atmosphere of the personality of Deity and the individuality of humanity.

BUDDHISM RAISED IMAGES; CHRISTIANITY BUILT HOSPITALS

Buddhism covered Japan with images, but Christianity built the first hospital. The Daibutsu (Great Buddha) at Kamakura, excelling as to its material and proportions all other bronze work on earth,



Photograph by Kiyoshi Sakamoto

FAN-MAKING IN JAPAN: DRYING THE "BONES" OF THE FAN

Regarded as an emblem of life that widens as the sticks radiate from the rivet, the fan is selected by the Japanese as a New Year's gift, and it is one of the gifts the bride takes with her to her husband's house. It is given to a youth upon the attainment of his majority, and is used as a signal by umpires of wrestling matches and by jugglers in feats of skill. Upon the presentation of a male child at birth to the temple of his father's deity, he receives two fans, while a girl is given a cake of pomade to bring good looks.

is a noble memorial of the man who has conquered his passions and lives in the calm of absorption in the soul of the universe.

Yet, in this embodiment of passivity, who could look for a true symbol of the New Japan, which was born after quickening from the West? Christianity comes with its democracy (so relentlessly opposed by lingering feudalism and so hated by the aristocracy and the general staff), its schools, colleges, hospitals, and its command, "Do." It wages eternal war against that Invisible Government which, besides being Japan's greatest curse, has been stronger than Mikado, diet, premier, or people.

Christianity rebukes that excess of reserve and that love of secrecy which have made Japan the object of suspicion everywhere, and which in individuals so tries the patience of their foreign friends.

Throughout Japanese history runs the stream of impersonality. In literature and in government the lack of individuality and the chronic difference between appearance and reality everywhere confront the student. If there be any place where "things are not what they seem," it is Japan; but most especially in her political life.

What has really made the New Japan is this emergence in social life of the new spirit of personality and of individuality. The old civilization was communal. The new national life is based, in the main, on the assertion of the inherent powers of the individual, yet in unity of purpose with the commonwealth.

The real Japanese of old was mostly agricultural, piscicultural, and marine; but to-day, instead of cottage industries, we have big business concerns and a vast population in mills.

Even yet, however, the Mikado's Empire does not consist, in the main, of travelers and bankers abroad, who use perhaps more than one language, wear swal-

A TELEPHONE OPERATOR OF TOKYO

During recent years the high cost of living forced thousands of Japanese girls from their homes into industry. There are now more than 12,000,000 girls and women at work, great numbers being employed in the telephone service and in the government postal and railway offices. In general, their hours are very long, running from ten or twelve to fifteen hours. Japan also has a child-labor problem, and there are many girls under twelve and fifteen years of age employed in factories.

low-tailed evening dress, and number five millions or so. The real Japan is made up of more than fifty millions of men and women in the countryside, in the mud of the rice fields, or along the seashore as fishers or junkmen, or of those who within a decade or two have crowded into the towns; for the industrial revolution is the greatest of the many through which Japan has passed.

Yet all this is out of proportion to the numbers of habitations amid fertile fields which are not, but could be, improved in the matter of soil production.

In Japan, how scanty is the live stock, how few, except as pack animals, are the horses! The milch cow is a rarity and the traction horse the exception.

MORE FARMERS NEEDED

Where China suffers from having too many farmers, Japan has relatively too few of the right sort.

With more than double the population of 1870, all checks having been removed, New Japan is too much an affair of cities and towns, with not enough soil improvement.

One can say this with truth, even with the figures of the last published census of 1920, in the digestion and publication of 1922, before him. Although in large cities and along the railway lines one sees milk bottles and wagons, there are not, in Japan proper, as many as 1,500,000 head of cattle; of horses there are somewhat more than that number; of sheep not 5,000; of hogs not 400,000—that is, there are but 24 cattle and 27 horses to every 1,000 people.

All this reveals a situation which requires hand labor in a disproportionate degree. Only in the Hokkaido, which is rich in live stock and notable for the application of ideas and things formerly unknown, but introduced by Americans since 1872, does one note a striking difference.

Japan needs a few million more cows, and horses that are able and willing to pull anything. If sheep are to be able to live and multiply, to furnish food and textile materials, the bamboo scrub must be pulled up. Grass rich in food material is the blessing of the temperate zone, and Japan might have it if she would.

These changes, with generous chemical alteratives and artificial fertilizers, would recreate Japan's soil, uplift labor, im-

Photograph from Centenary Committee, M. E. Church

JAPANESE CHILDREN WITH THEIR NATIONAL FLAG

One can always see children and flags in Japan, and it is the attractive youngsters dressed like dolls, and the red and white sun flag that give color to much of the patriotism for which Japan is renowned.

prove the countryside, the homestead in its exterior surroundings, and the interior of the house.

DRAB PEASANT LIFE RELIEVED BY PILGRIMAGES

The drabness of peasant life in Japan has been and is relieved chiefly by pilgrimages; yet in the career of Lafcadio Hearn, whose amazing powers of mind and pen were used to idealize Japanese existence, we have both a parable and a revelation. His later awful revulsion of feeling affords the parable. It was "Hail" and a "kiss," with "grace, mercy, and peace," at first. It was "D—n the Japanese" at the last. Yet whose fault was this? His first books border on the lackadaisical. He wrote panegyrics. His last one, "An Interpretation," it would pay a missionary society to subsidize.

Surely one can be loyal to his own race and civilization without either glorifying or laying anathema on the Japanese as a "lesser breed," or denouncing wholly their systems, social or political.

To some minds, Lafcadio Hearnism and Pierre Loti-ism work immeasurable injury to Japan by mental recoil and reaction. Myriads of tourists (averaging 15,000 a year), "fed up" on these authors, come to the shores of Nippon to behold and enjoy; yet, also, to taste too often Dead Sea fruit; or to find, instead of visible facts, only "the baseless fabric of a vision."

Such mischievous idealization of a people is like that of making an angel—of the stained-glass notion and pattern—of woman, and then discovering she is human.

The "mid-Victorian" Japan, thus glorified, has now given place to the South Sea Islands as a subject to be transfigured by authors reveling in sensuousness with captivating style. Hence, the rush thither of young men, sensualists with or without wealth. In the early Meiji days and before, Japan was as full of these adventurers as are the proverbial woods of Mississippi with the children of the colored folks.

But to return to our muttons, to our cows and to our horses. Such an animal as a milch cow, of the sort with which we are acquainted, was unknown to the Japan of 1870. A sheep was an extreme rarity. But now there are apostles of the new gospel of pasture and fields for the wool-bearing friends of man. These are both students and practical men, who have mastered the literature of the subject and have studied the economic side of the great enterprise, which made England rich and the woolsack a seat of highest honor.

Learned in the matter of diseases and dangers in the case, these men proceed to eradicate the bamboo scrub, which, in the sheep's stomach, cuts to pieces its digestive canal.

TWO MEN REQUIRED TO MILK A COW

Sadly missing from Japan's literature are the rich imagery and appeals to the imagination of the shepherd and shepherdess, and from her dietary the realities of "lamb, ram, sheep, and mutton," besides the loss to industry, trade, and the landscape. To multiply sheep in Japan will be an enormous gift to Japan's civilization. She needs the ram's horns and the ewe's udder in her cornucopia, which locally is in the form of "the rake of prosperity" usually associated with the happy old couple of Takasago.

When one American lactifer was imported, two strong Japanese men were selected as "milkmaids," the male sex and muscular strength being important considerations.

The fluid extracted proved to be the fountain of life to a boy suffering from marasmus—a case which had proved hopeless under the Japanese physician's hand. After critical examination, our Dr. Hepburn advised a pint of milk three times daily, but nothing else different from ordinary diet. The youth's health was resurrected, and he is now in his eighty-eighth year.

But in 1870 no native cow would allow liberties to be taken with her, and two men might work an hour before they got a quart of milk; for public opinion in the bovine world was not in favor of milk for human beings, except possibly for very old people and infants. This opinion was shared by human beings quite generally.

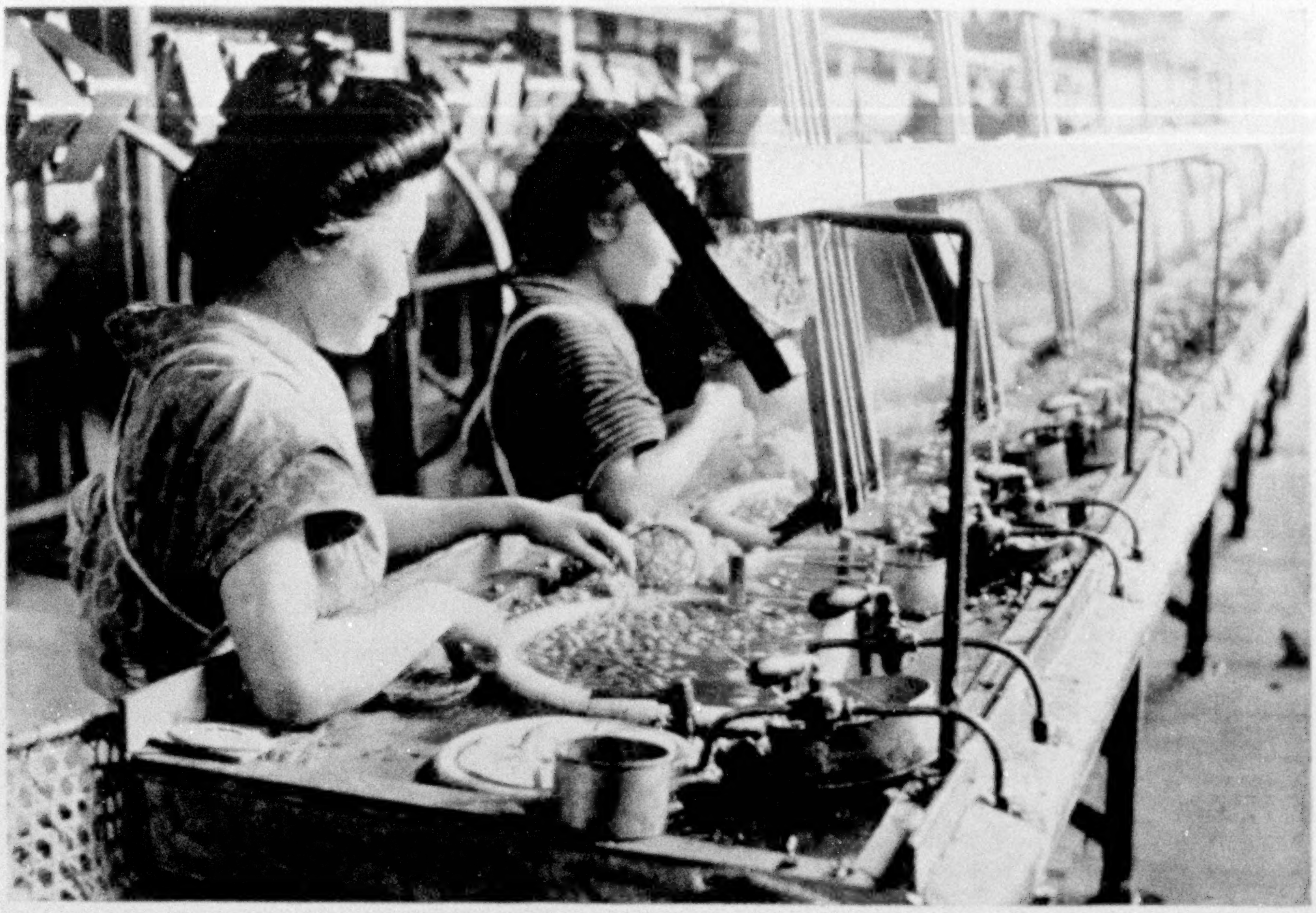
HORSES REBELLED AT LABOR

In 1870, also, no native horse was in use, except for pack or saddle work. Men went barefoot and pulled or pushed the cart. The horses wore straw gaiters and drank out of dippers filled by men; but traction was beneath their dignity. The muscles of the *uma* were not developed for horizontal work.

When to my friend, R. H. Brunton, the English engineer and lighthouse builder, was assigned the task of laying out the streets and making the curbings, culverts, gutters, and pavements of Yokohama, he took it for granted that the Japanese horse would coöperate with him.

Vain thought! He, supposing that horses at the ends of the earth were of the same temperament and utility as British nags, sent to London for a set of the best English harness. In his home, men and their four-footed friends were so well acquainted with each other that those on four feet could push, pull, carry weights, bear burdens horizontally as well as vertically, and even leap fences and tread mills, up or down. Why not their cousins overseas?

In this course of reasoning, however, Brunton reckoned without his stallions, as they all were in this assigned region of the Land of the Gods, for the whole country was mapped out in lines of demarcation that kept the genders apart.



JAPANESE FACTORY GIRLS WORKING WITH COCOONS

The yellow silk filature cocoons are placed in hot water to loosen the silk and to facilitate the unwinding. A pound of raw silk requires from 2,500 to 3,000 cocoons, each cocoon furnishing a filament of perhaps 600 yards in length. The work of 5,000 silkworms is needed for one kimona. In the silk factories, Japanese girls receive from 15 to 20 cents a day. Japan is the world's largest producer of raw silk, for which the United States is her best customer. Before the earthquake Yokohama was the clearing-house for this product.

When he attempted to try the new equine toggery on the native beasts, the result was a surprise and the end an experience. An equine brainstorm, with legs and feet active in every direction, frustrated British benevolence and enterprise. No respectable horse, in the land where the horse was sacred, worshiped, and kept in the temple stalls as a divinity, would humiliate and degrade himself by labor that was fit only for men!

So Brunton had to rely wholly upon hands, and Yokohama was graded, dressed, and finished with human labor alone, while the laughter of the equine deities was more real than metaphorical.

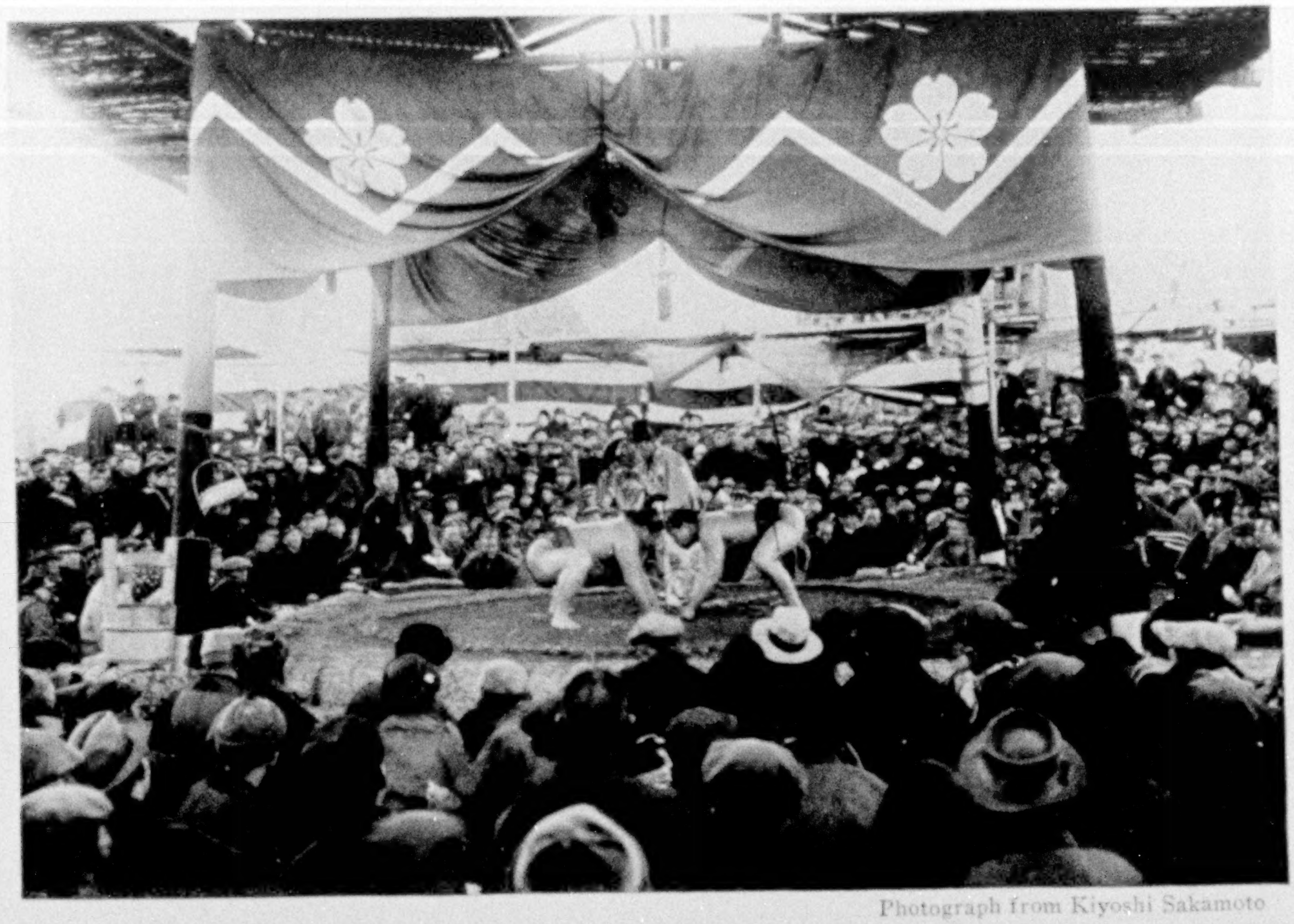
JAPAN'S SOIL CAN SUPPORT TWICE THE PRESENT POPULATION

Despite the fact that the Japanese have been "farmers for fifteen centuries" and the Chinese for forty, there are some elements of success now counted among us as the *a, b, c* of agriculture, such as the selection of seeds and stock, which as principles were virtually unknown among the Japanese in old days; nor has the handful of professors and scientific men in Japan to-day as yet greatly altered the situation.

From what I saw during four years, I believe with others, who know a thousand-fold more on the subject, that Japan's soil, when properly treated, can furnish food for a population at least twice as great as is now there; and that the importation of food, except in the fancy and not staple elements, may be rendered unnecessary.

In spite of the plethora of statistics of visible progress, I cannot but think that the idea of some of her statesmen, so often reiterated as to become a dogma, that Japan must continue wholly in maritime and industrial expansion, depending on the Asian continent for her raw material, thus tempting the nation to delusive enterprise and to hostile aggression, is a mistake that invites ultimate disaster.

Such a notion has certainly made the



Photograph from Kiyoshi Sakamoto

THE TENSE MOMENT BEFORE A JAPANESE WRESTLING MATCH BEGINS

They have stamped their feet, eaten their salt, rinsed their mouths, slapped their knees, and are waiting the signal to clinch. The distinctly Japanese type of wrestling, known as jujutsu, became popular in Japan in the sixteenth century, having been introduced by Akiyama, a noted physician, who learned it in China and elaborated greatly on the original methods. It has always been semi-secret in character, being taught only after the pupil has taken an oath not to reveal the knowledge. A master in the art can by a slight, quick movement break a man's neck, ankle, dislocate his hip or shoulder, burst or twist a tendon, or benumb his brain.

world suspicious of Japan as "a neighbor-disturbing nation," if not as a pride-swollen marauder.

In reverse of this idea, my conviction is that, for ultimate benefit and solid prosperity, Japan should strengthen the foundations by further uplifting her people, improving her soil, and developing her innate resources. The admiration of the world for her military and naval triumphs all too quickly changed into suspicion, envy, and hatred. Her nobler racial, esthetic, intellectual, and moral qualities will ever gain the confidence and win the increasing admiration and respect of mankind.

JAPAN'S ENTRY INTO THE ARENA OF WORLD TRADE

Having faced some of the shadows on Japan's dial, we may now glance at the full sunlight of her prosperity and look into some of the reasons for it, with hope for its continuance.

Both the age-period and the manner of the double summons to Japan to awake to new life seem unique in human history. In a word, time and circumstance wrought in harmony. From within, through long mental preparation and the call of noble souls, and from without, by the forces of the westward movement of the race and by direct American impact, Dai Nippon received her mandate. This came at a time when the forces of nature and the appliances of civilization were at their highest.

With the momentum gathered during more than two centuries of peace, the Japanese utilized and applied these new forces at once. In a word, they leaped like athletes into the arena to meet the clash of industrial revolution, and even dared to face competition with the older manufacturing nations.

Until about 1750, man had invented nothing greater than himself. Thenceforth, from Franklin's and Stephenson's era, he began to harness the potencies of Nature and to make the mystery of electricity and what he called steam serve him.

Hence Japan, doubly alert and equipped by long inward intellectual discipline and through the prolonged stimulus given by the Dutch, by Commodore Perry and Townsend Harris, and by the 5,000 foreign teachers of every sort, grappled at once, as competitor, with even the greatest of nations.

The ancient proverb of "the hermit in the market-place" became a reality. Transformed, in a generation, from an island recluse to princely magnificence, Fair Japan became also a Rasselas with new hope and ambitions, but also with novel perplexities and unexpected problems.

JAPAN SERVED A LONG APPRENTICESHIP

I feel quite sure of the truth of my assertion that the victorious and sanguine young men of 1867, most of whom I knew fairly well and who later became the genro, or elder statesmen, had colossal expectations. A decade or so would suffice, they thought, to transform Japan into a fully equipped modern nation; for with Yamato Damashii (the spirit of unconquerable Japan), transmitted in unbroken succession from the Age of the Gods and then in volcanic outburst, what obstacles could not be overleaped? In self-belief and self-assertion, none can excel the normal Japanese—unless it be an American. "They can, because they think they can."

In the world outside of the chain of islands at the ends of the earth, this vision paled and vanished before the light of common day, and the project utterly fled before experience. Yet Japan was in many ways saved the long apprenticeship of European nations, because, even more than the hero of Locksley Hall, she soon found out that she was "the heir of all the ages, in the foremost files of time," and was able at once to utilize in fullest efficiency the grains of the centuries and the resources of Western civilization.

Hence, within a single lifetime and in some instances within a decade, the adoption of new political and social systems, post routes, telegraphs, telephones, steamship lines, and modern costume!

In illumination, no slow processes from a saucer of oil and a pith wick to Drummond light or Mazda! With the affluence of water power, already at hand in a chain of islands thrown up by volcanoes, rich in mountain ranges with innumerable branches and spurs, where precipices and waterfalls were uncounted, the story of Prometheus was thrown into shadow. Chained to a thousand rocks were the electric lights of beacons that made a shining path in the ocean along a once dangerous coast.

With this fire stolen from heaven, the great cities, instead of their streets, as of old, showing a myriad of dancing, colorful lanterns at night, now have, row upon row, long miles of iron standards holding the incandescent arcs, while in the common business of catching thieves and draining mines and swamps, the electric current is kept ever busy.

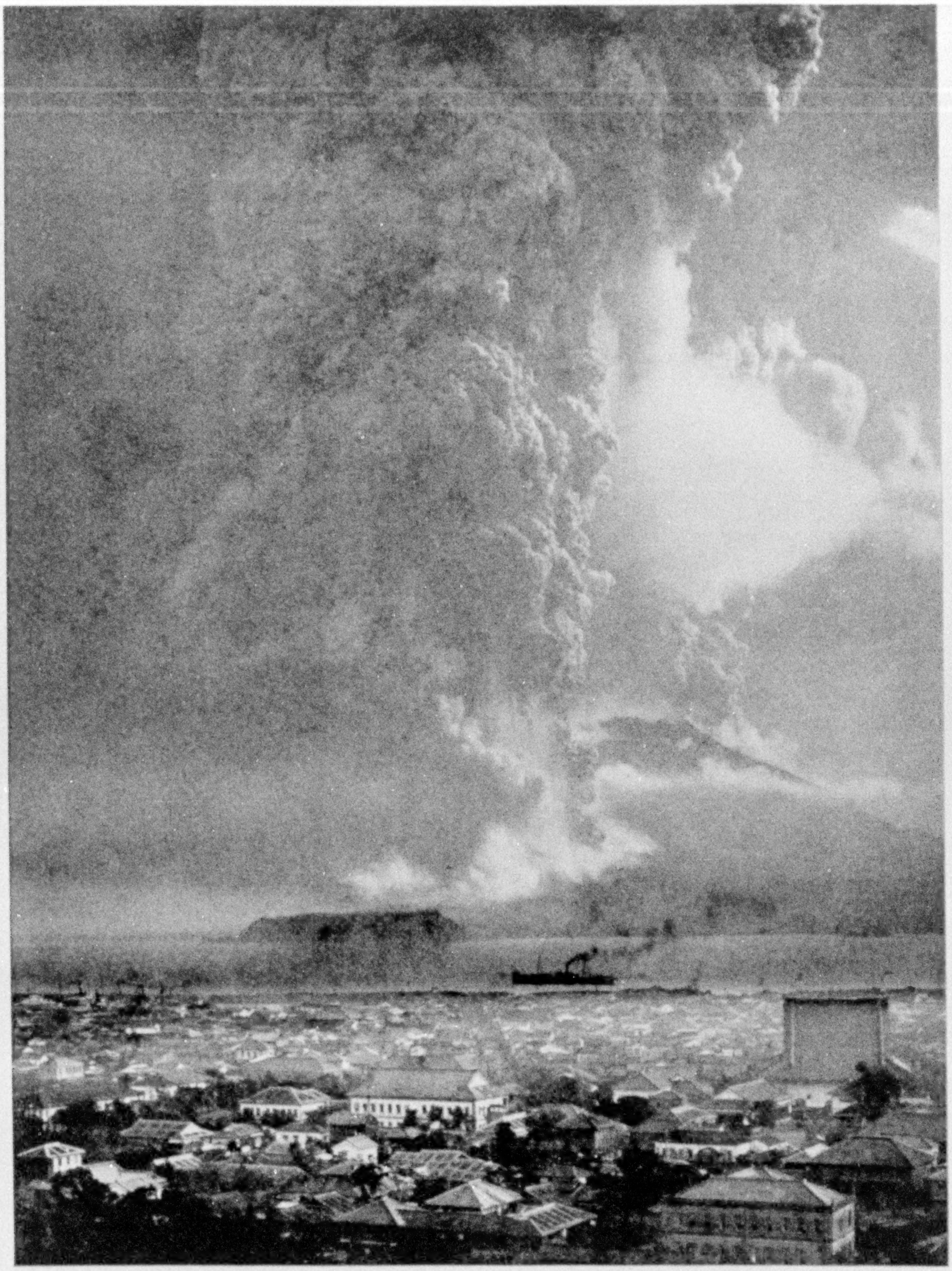
To those with memories of the early seventies, the old fairy tales of power, as displayed by imps and dragons, seem outdone in the pragmatic statistics of 1920.

For cooking, lighting, heating and motor power of all sorts, there were in that year 1,333,243 kilowatts harnessed to human service—a figure vastly increased in this year of grace 1923 and of the Japanese Empire, as officially stated, the 2583rd.

One commercial envoy, who after a visit to Japan had failed to "land" a big order, returned to America with only blasphemy of the Japanese, classifying them among the worthless and the damned. Another, who brought back an order for millions to the electric city of Schenectady, keeps in perpetual motion of praise the virtues of the canny islanders. On reception in Japan of news of the signing of the Portsmouth Treaty in 1905 (by Count Komura, one of my former pupils during three years) a cablegram ordering $5,000,000 worth of electric equipment was received by an American company.

AN ILLUMINATING INCIDENT OF THE RUSSO-JAPANESE WAR

During the war with Russia, as an American regular army officer who was



Photograph from Dr. T. A. Jaggar, Jr.

SAKURAJIMA VOLCANO IN ERUPTION, WITH THE CITY OF KAGOSHIMA IN THE FOREGROUND

This remarkable photograph of the greatest volcanic eruption which has occurred in Japan in modern times was sent to the National Geographic Society by Dr. T. A. Jaggar, Jr., Professor of Geology in the Massachusetts Institute of Technology and Director of the Hawaiian Volcano Observatory. Dr. Jaggar is now in Japan, having been directed by the U. S. Secretary of Agriculture to proceed to the stricken country to aid Professor Omori, head of the Japanese Earthquake Commission, in studying the recent disaster. The great Sakurajima eruption occurred in January, 1914. The center of Kagoshima, a city of 70,000 inhabitants, was only four miles from the volcanic crater, but, as by a miracle, no lives were lost during the volcanic discharges.

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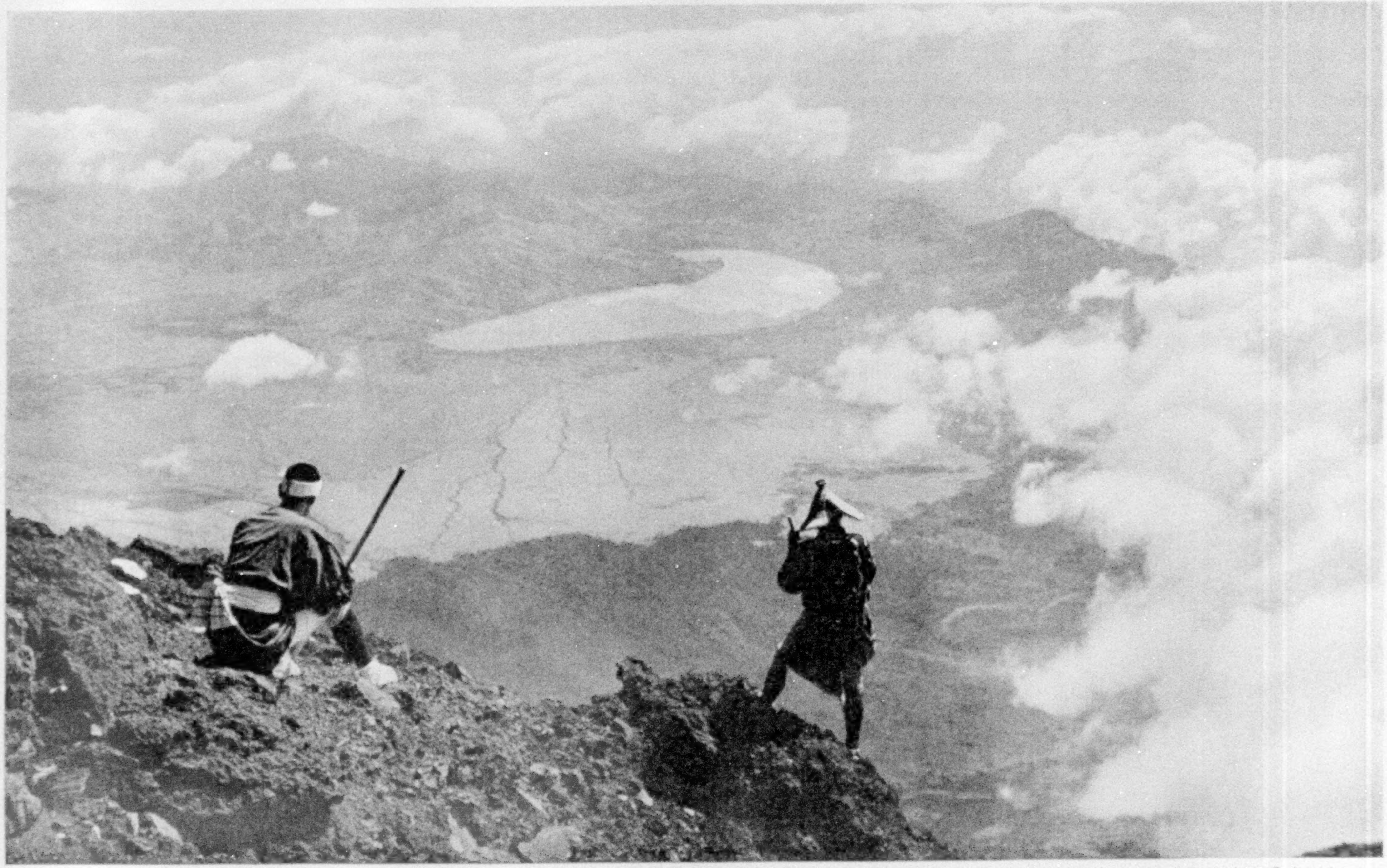

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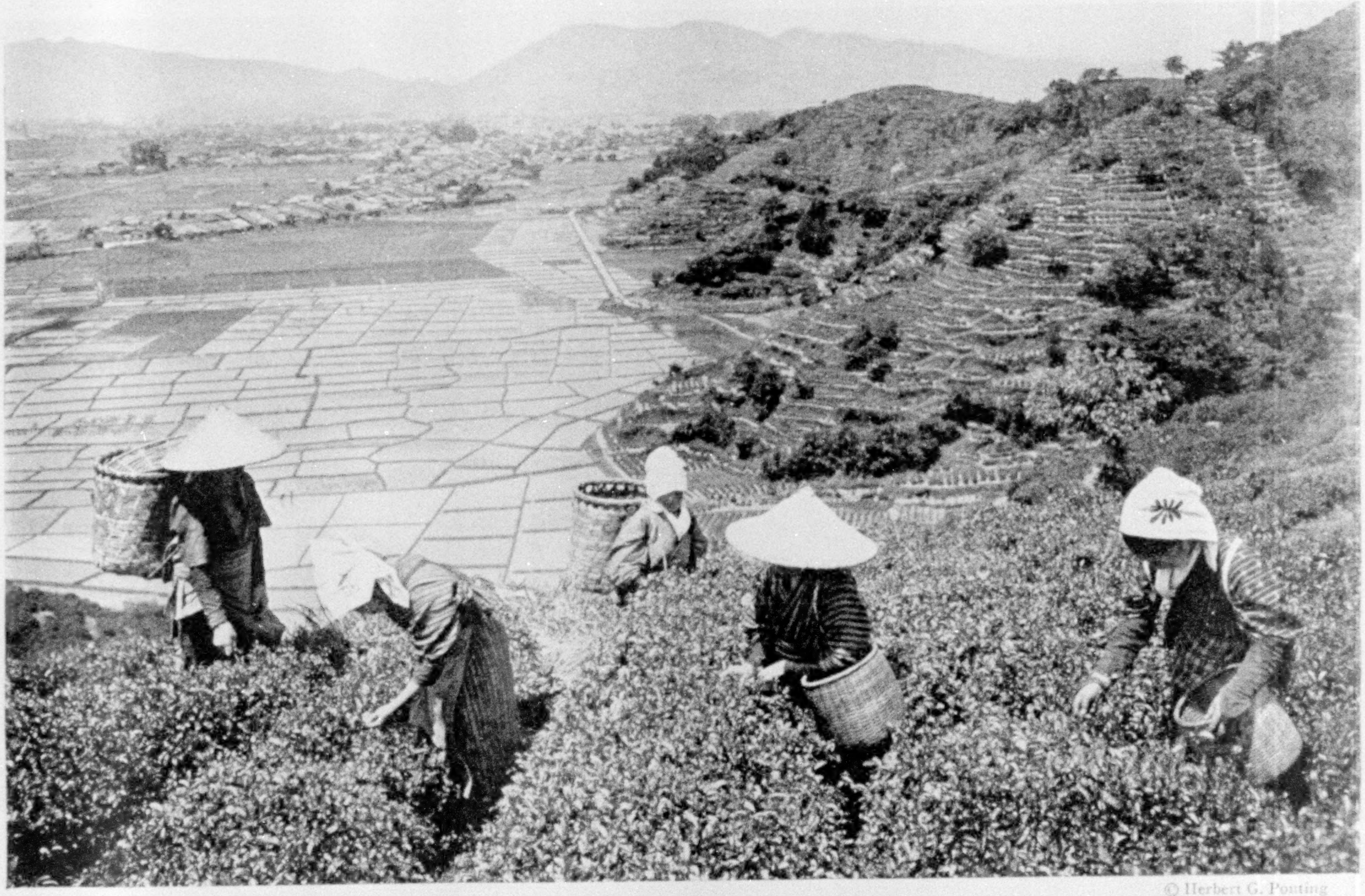
LAKE YAMANAKA FROM THE SUMMIT OF FUJIYAMA

This lake lies at an altitude of 3,270 feet, higher than any other lake on Mount Fuji. The Japanese also call it "Three-Days'-Moon Lake," because it is similar in shape to the moon at that phase.



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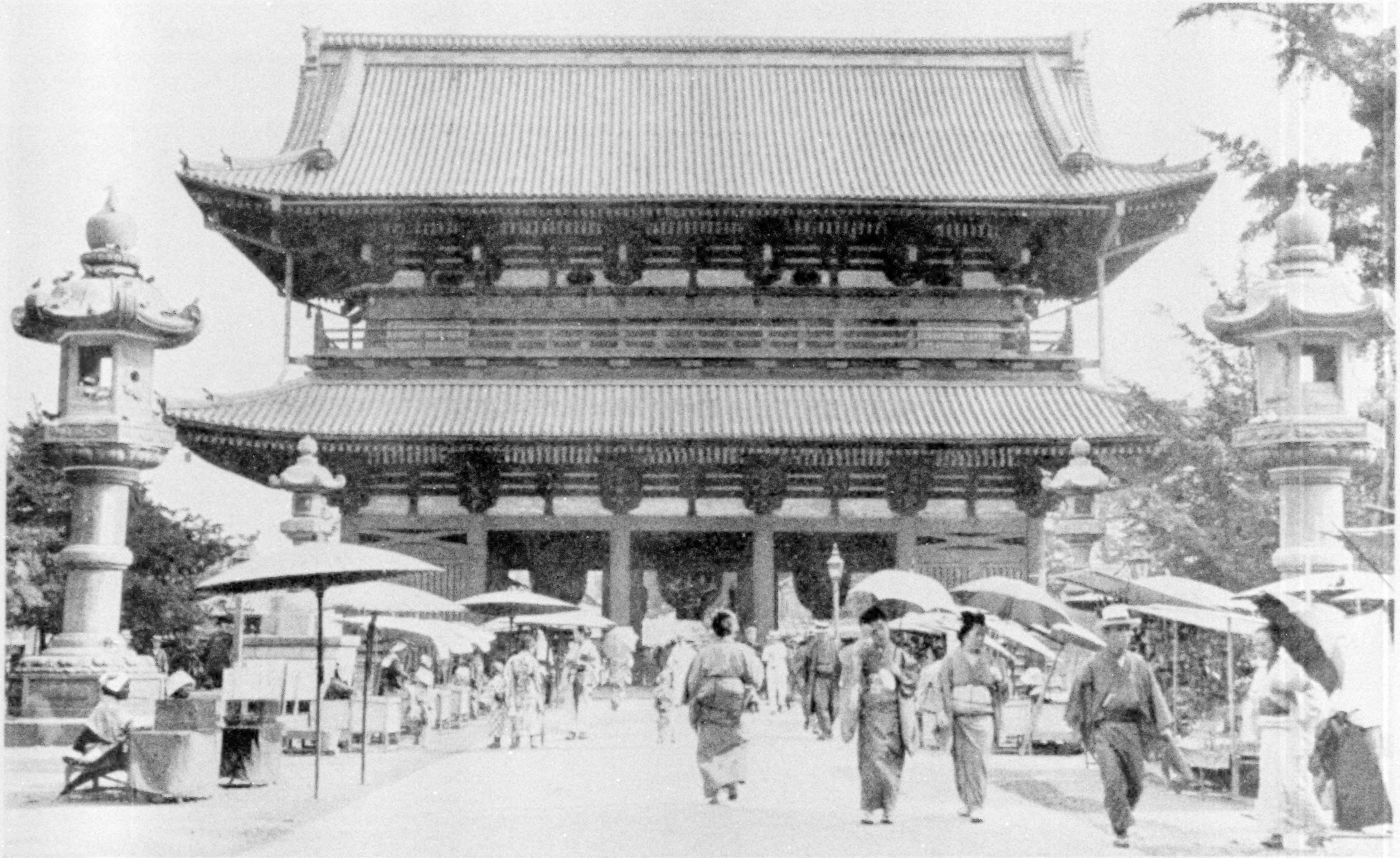
PICKING TEA ON THE HILLS AND GROWING RICE ON THE PLAINS: JAPAN

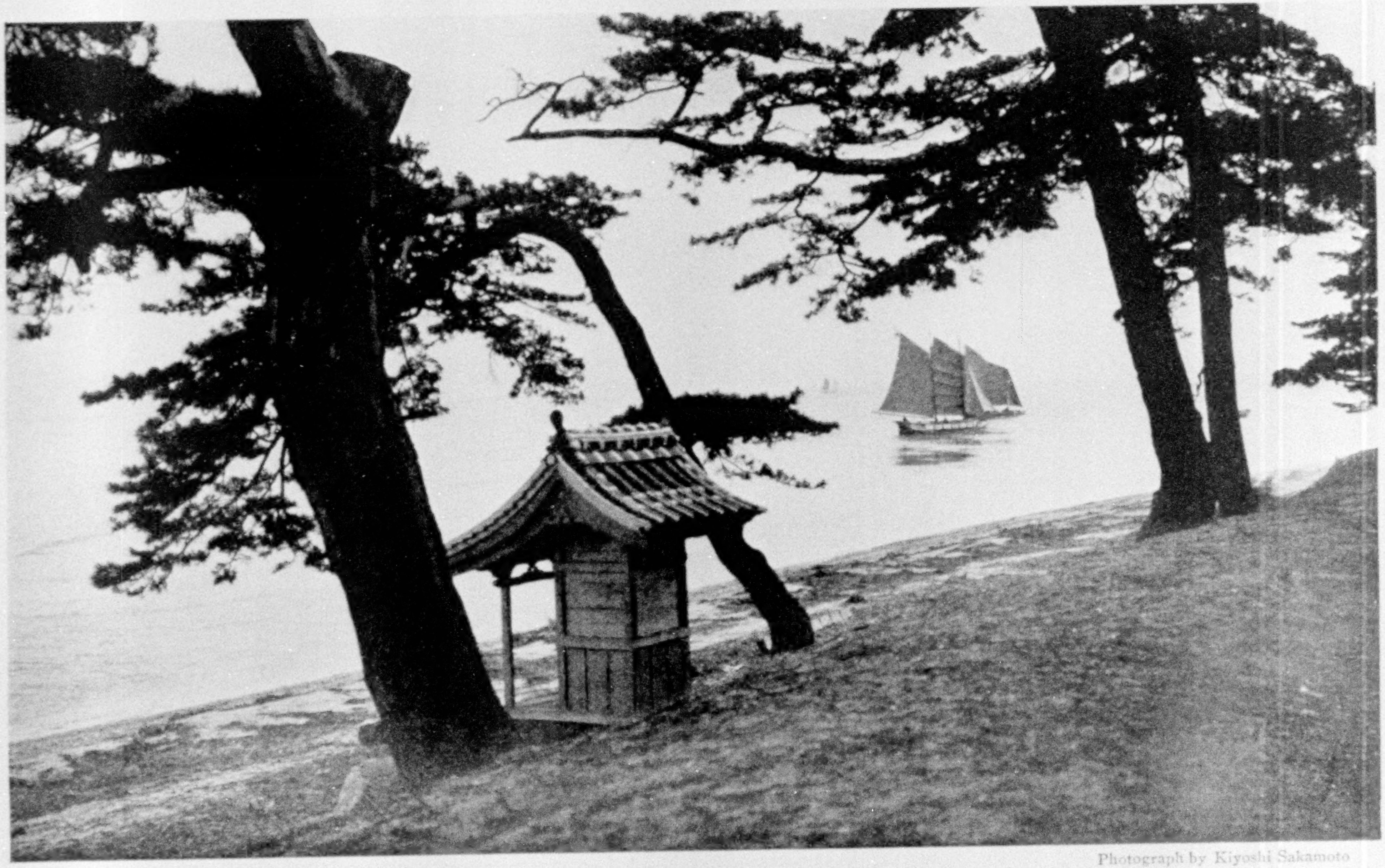
The largest tea-growing district in Japan centers about the town of Shizuoka. About one million Japanese are employed in raising tea, and 120,000 acres of land are required. The best leaf is grown around Kyoto, but most of it is consumed in Japan itself. All leaves must be picked by hand, and at the busy season every man, woman, and child goes out to labor. After picking, the tea is dried and fired, and the method of firing determines whether the tea shall be "green" or "black." The white squares in the background are rice fields.



Photograph by C. H. Kragh

ENTRANCE TO THE TEMPLE IN ASAKUSA PARK, TOKYO

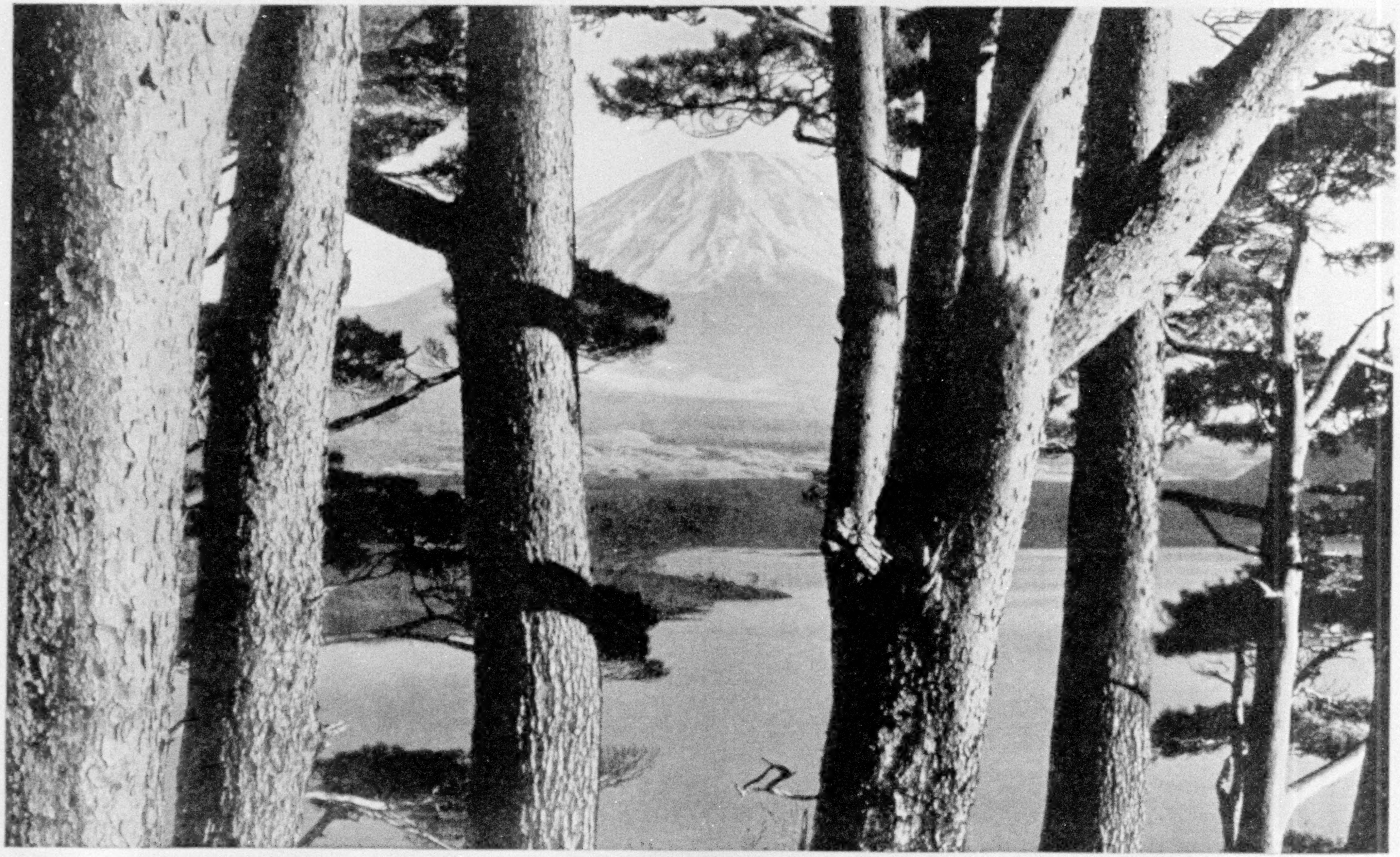
Asakusa is dedicated to Kwannon, Goddess of Mercy, who descended into hell, delivered the condemned, and showered upon them a rain of flowers. This entrance is a sort of façade or pagoda to enhance the importance of the main entrance. Before the earthquake the most popular holiday festival for the lower and middle classes was held near this temple. The long street approaching it was filled with toy shops, tea houses, theaters, and merchants' booths. At wayside stalls tiny rings of perfumed paste could be purchased to burn in honor of the goddess, and also saucers of rice for the sacred pigeons.



Photograph by Kiyoshi Sakamoto

A SHRINE ON THE SEASHORE

The artistic sense of the Japanese is well evidenced, in that the national fête days are festivals of Nature. In the autumn the hours of sleep are changed to daytime, so that the people may be free to enjoy the beauties of moonlight.



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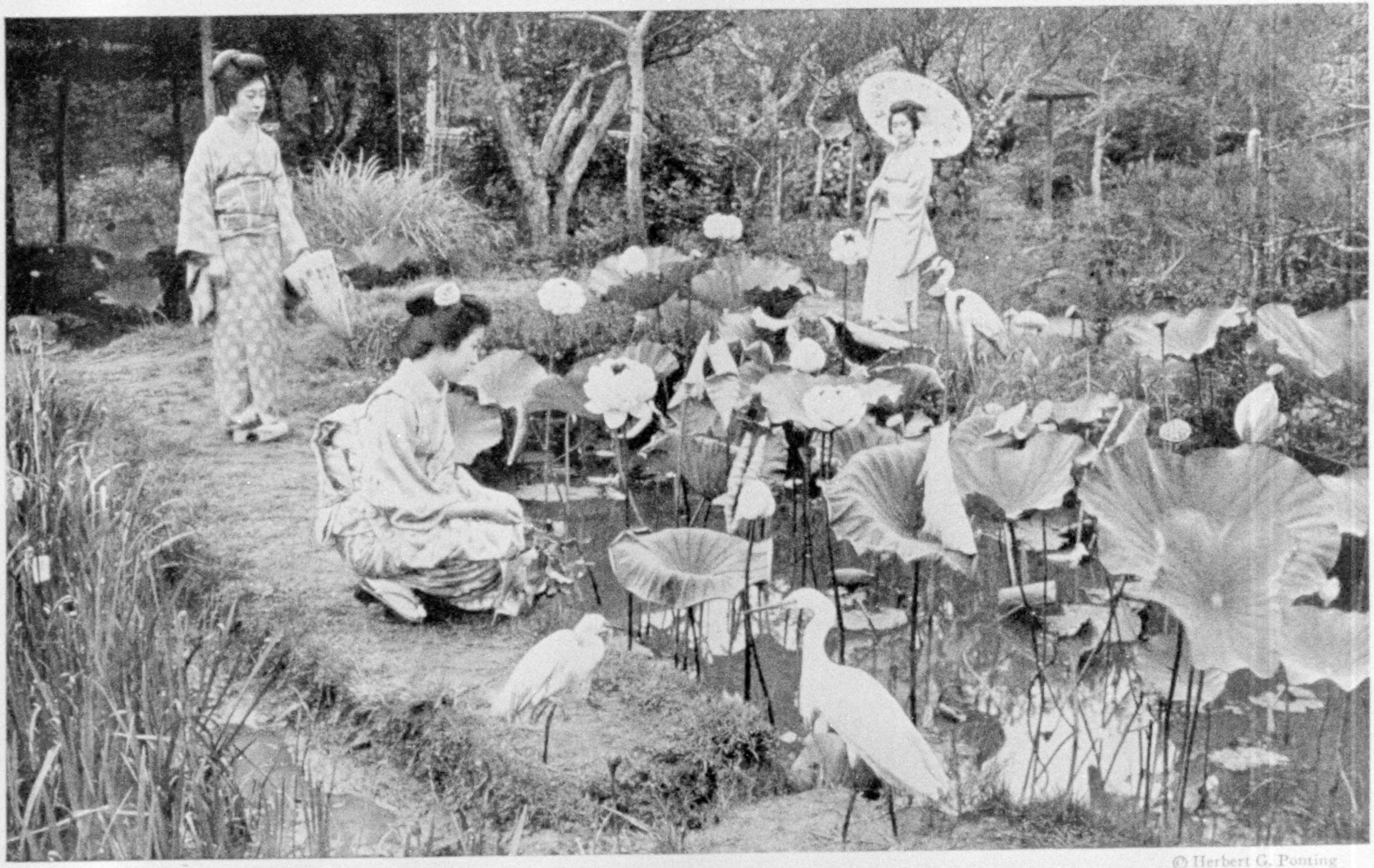
FUJI THROUGH THE PINES



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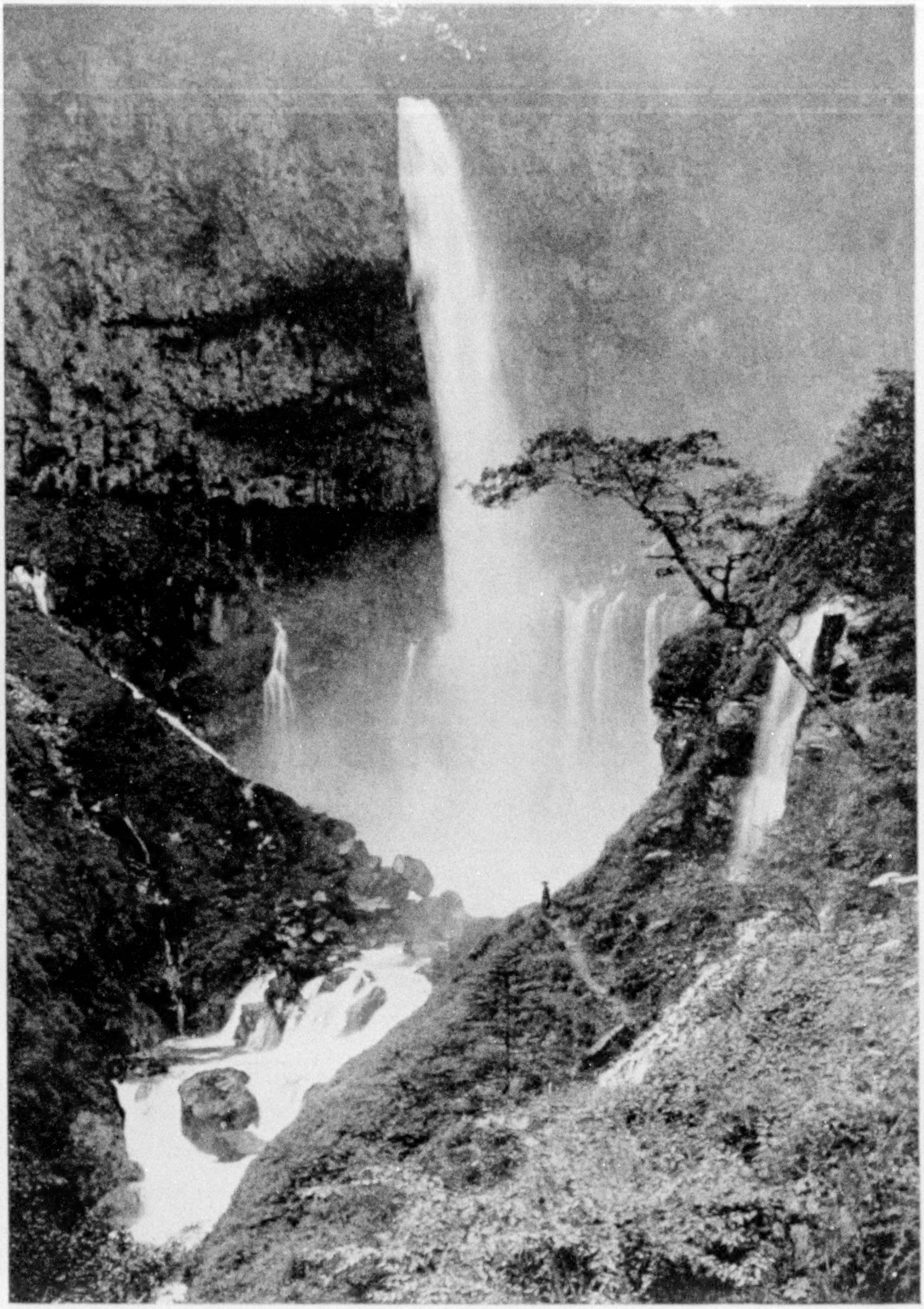
SUMMER AFTERNOON IN A LOTUS GARDEN

These handsome flowers push up from the ooze and unfold heavily corded green leaves measuring two feet in diameter. The lotus is the sacred emblem of Buddhism, and many of the fountains in the temples are in the shape of this flower. It symbolizes triumph over self; extinction of the fires of passion, abnegation and self-control, and is accepted as a token of all that is best in man and woman.



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KEGON FALLS AT CHUZENJI

The hamlet of Chuzenji lies 10 miles from Nikko, on the shores of Lake Chuzenji, a body of fresh water 15 miles in circumference. The lake belongs to the imperial household, which has stocked it with fish. It is also known as the "Lake of Blessedness," because it was blessed by the Emperor Meiji when he was there in 1876.

a witness told me, some of the Tsar's *mujik* soldiers cut down the telephone and telegraph wires within their own lines to bale their hay and mend their long boots! On the Japanese side, telephones and telegraphs, with trained operators to use them, were as familiar as cartridges.

I believe I imported the first electric machine and the first portable fire-extinguisher into Japan. In 1919, there were 95,877 stations generating electricity, making use of motors of all sorts, with both water and fire as agents. Hundreds of small villages are now lighted at night by electricity, and in them motors of many kinds are used by day.

The use of gas in mills, factories, shops, kitchens, and for varied appliances has developed in like manner, the number of cubic meters of gas generated for service in 1919-20 amounting to 275,210,682.

In the large cities more than 70 companies operate electric trolley cars, which in 1919-20 carried 1,211,147,504 passengers. For smaller places and for mining, wheeled vehicles are moved by electricity, by steam, and by man power.

FIRST JAPANESE SCHOOL OF TECHNOLOGY ESTABLISHED IN 1871

To those who would penetrate the secret of Japan's rapid development and world-encompassing ambitions, another historical fact is worth noting, especially in comparison with our own national development. Let one scan the meager list of technical schools in the United States in 1871. Except for the Rensselaer Polytechnic of Troy, New York; the Stevens Institute at Hoboken, New Jersey, and the rudimentary state of things at Yale, at Harvard, and at the Massachusetts Institute of Technology, and the infant Cornell University, how feebly developed they were!

In 1871, after a study of Japan's nascent plans for a national system of education, even before there was the Mom Bu Sho, or Department of Education, I had the honor of writing from the interior, at Fukui, and suggesting that a school of technology and of manual training be established in the capital.

The letter reached Tokyo on the very day of decision by the Dai Jo Kan (Supreme Government Council) to create the Department of Education, and I was summoned to Tokyo to establish such a school.

The scheme at first comprised only four professorships—chemistry, physics, engineering, and law (!), with which last astonishing enterprise I had nothing to do. Later, after the return of the embassy from Europe, this first attempt was happily absorbed in a larger foundation, with a dozen professors.

In the twenty or more years of the existence of this institution, under the Department of Communications, there were educated the engineers, architects, chemists, and others who built Japan's steamships, railways, lighthouses, and laboratories, which helped to modernize the face of the country. These gave Japan new tools and weapons, a new suit of armor, and, under all, a new nervous and circulatory system.

With a total of more than 7,000 miles of railway in operation, her resources are still in process of development. Six thousand steamers and nearly 50,000 sailing ships, with a total tonnage of 4,180,305, tell the story. In 1871 my letters and mail matter came to me in the far inland city by runners. In 1923 Japan has nearly 9,000 post offices (in which two-thirds of the employees are women), with 65,000 post boxes. Telegraphs, telephones, and radio stations are commonplaces.

There are special schools of medicine, jurisprudence, commerce and pedagogy in the five national universities, with nearly 500 professorships, the faculties numbering over 1,000 professors and 10,000 students. In addition, there are as many nongovernment universities, which have in total as many pupils and keep up a wholesome rivalry. Of the technical schools — arts and crafts, agriculture, marine industry, etc. — there are more than 250, with more than 80,000 pupils, counting both sexes.

THE ACORN PRODUCES THE STURDY OAK IN 53 YEARS

The acorn of 1870 has become the oak of 1923; but it was planted in a soil made of the enriched mold of a thousand years of culture. The alien of that year, on landing, saw no chimneys, milk wagons,

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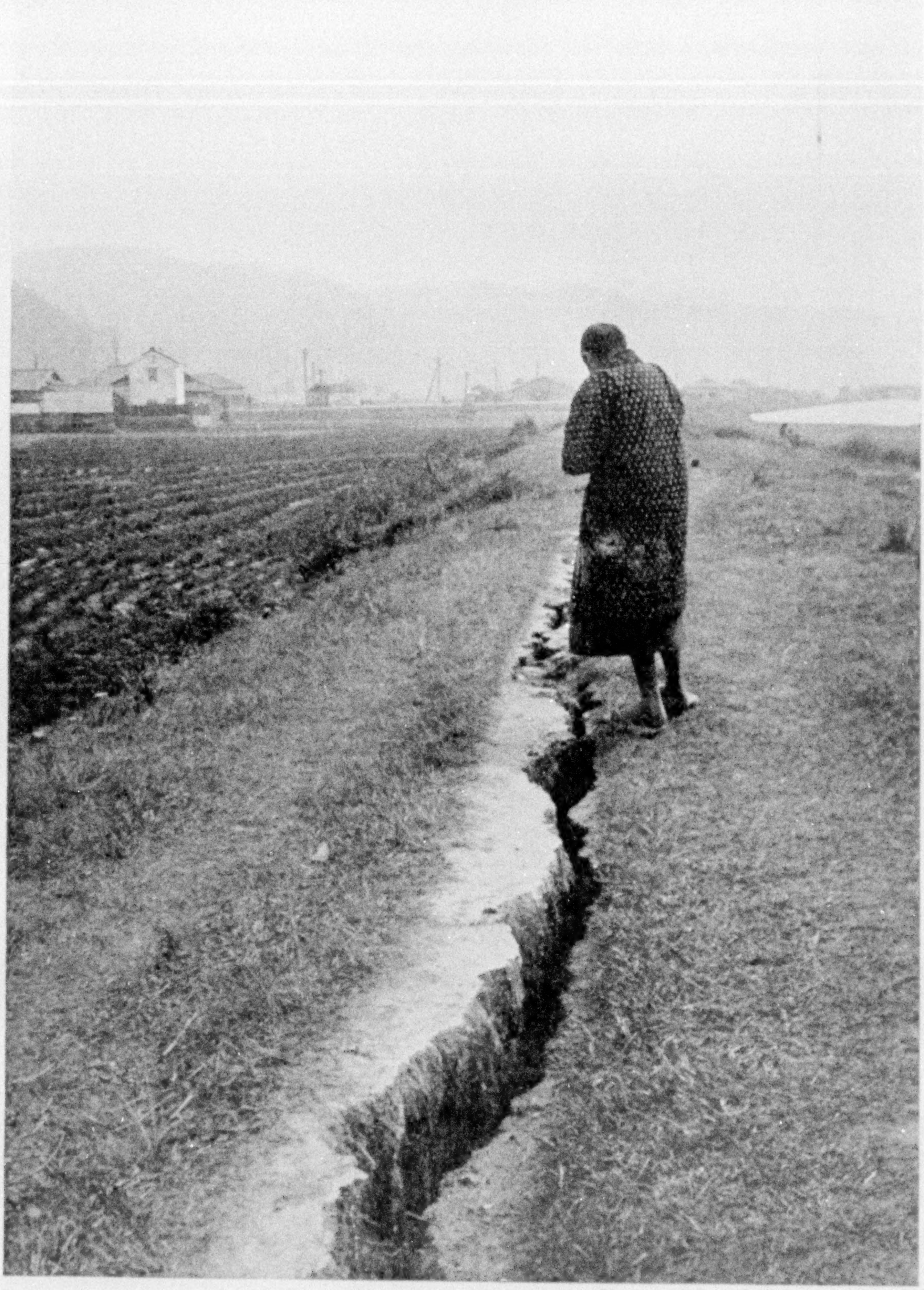

Photograph from Dr. T. A. Jaggar, Jr.

EARTHQUAKE CRACK IN A DIKE OF MADE LAND ON THE KAGOSHIMA PLAIN

A photographic record of the awesome "yawning" of the earth during the quake which followed the great eruption of the Sakurajima Volcano (see illustration, page 433). Dr. T. A. Jaggar, Jr., the volcanologist and authority on earthquakes, has furnished The Geographic with a vivid translation of a Japanese account of "The Burning of Sakurajima in the eighth year of Anyei Era" (A. D. 1779), in which the ancient chronicler says: "Ordinary earthquakes feel like a boat rocked by the waves, but these were different—even as a horse, after a scrubbing, shakes his mane. The noises were as of the cry of some mountain birds. The doors and paper screens rattled like hail upon the roof."

water-works, newspapers — few indeed of the externals of what he was wont to consider modern civilization; but culture, fine manners, literature, alert minds, and lovers of the good and the beautiful he found everywhere.

Whatever Japan gains, may she not lose the best of her ancient beauties and inheritances.

In summing up the results of impressions, studies, and experiences of more than two-thirds of a fairly long lifetime, I utter my faith in the Japanese. I have witnessed feudalism, centralization, imperialism, constitutional and party government, with progress in every line of human achievement, yet with the same ebbing and flowing of opinion and policy, as influenced by Europe and America. Having also made myself acquainted to some extent with the invisible forces and inherited ideals of the Japanese, as revealed in their history, literature, and art, I retain my confidence in them.

I cannot but feel that with them rest in great measure the hopes of Asia, and that, next to the United States, Japan can be the chief medium in the union and reconciliation of the Orient and the Occident for the making of a new world.

THE CAUSE OF EARTHQUAKES

By Robert F. Griggs

Leader of the National Geographic Society's Mt. Katmai Expeditions

THE unexampled disaster that has so suddenly overtaken the capital of Nippon inevitably raises the question, Why such calamities? What is the cause of earthquakes? Why are some regions especially subject to them? Can anything be done to predict or alleviate these calamities?

An earthquake is one of the few things in this world whose name accurately and adequately describes it. The earth, being highly elastic, like "a bowlful of jelly," may be set a-tremble by any shock sufficiently violent. Miniature tremors are caused by the passage of every train of cars. The explosion of a powder magazine sets up a somewhat greater disturbance. But nearly all great earthquakes are due to a single cause—the sudden breaking of the rocks under a strain too great for them to bear.

The fracture which sets the earth to vibrating may result in a large displacement of the rocks, and the break may be traceable for many miles. The fracture, or "fault,"* of the Mino and Owari earthquake of October 28, 1891, extended for 70 miles and cut clear across the main island of Japan. In several places the vertical break amounted to 20 feet, and half as much displacement was common. The horizontal movement averaged about six feet.

CHIEF DAMAGE DUE TO VIBRATIONS, NOT TO SHIFT OF THE GROUND

The damage from earthquakes comes, however, from the vibration rather than the actual shift of the ground. From the displacement on the fault line and the way in which surface objects are tossed about, it is natural to infer that the earth must move considerable distances back and forth during the shock. But this is not correct. Most of the vibrations are only a fraction of an inch in length. It is the suddenness, rather than the amount of motion, that does the damage.

But no one who has experienced the dizzy swaying of *terra firma* during an earthquake, or even examined pictures of earthquake damage, can readily persuade himself that the tremors can be of such small dimensions as the recording instruments prove.

The case is somewhat like that of a marble, which jumps several inches in the air when the floor on which it rests is suddenly struck with a hammer. The

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* "Fault" is a term, derived from mining parlance, applied to a fracture and displacement of the rocks. The appropriateness of the term is not evident until one puts himself in the place of a miner digging along a mineral stratum which abruptly disappears when he reaches a place of shearing in the rocks. From his point of view, the rock is evidently enough "faulty."

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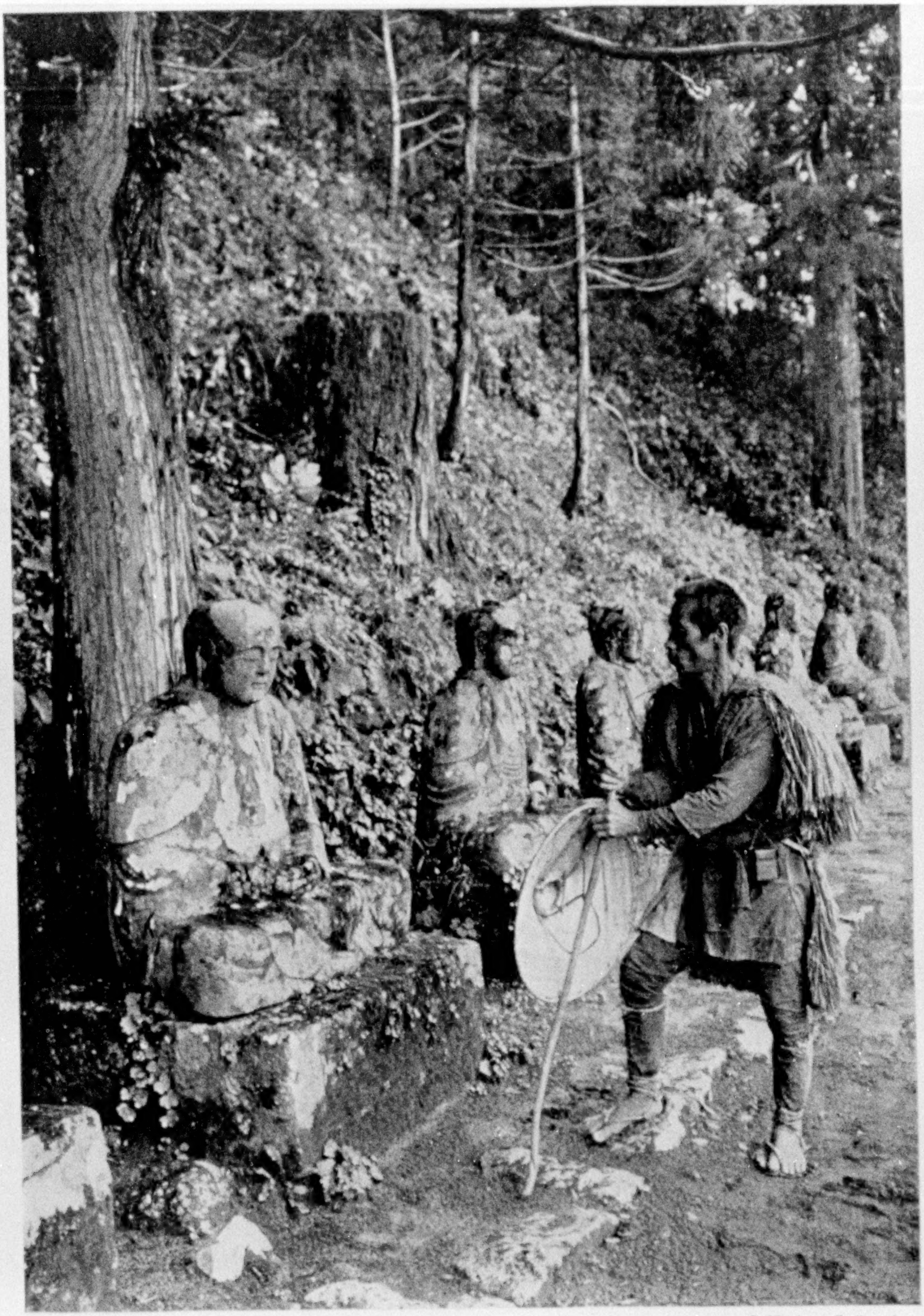
UNDER THE PURPLE WISTARIAS IN JAPAN

The homes and temple gardens of Japan are famed for their beautiful flowers in season. The plum blossoms of February are followed by the cherry blossoms of April and the wistaria shortly after, the lotus in July, azaleas in midsummer, chrysanthemums in October, camellias in December, and evergreens the year round.



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MEDITATION: A STUDY AT NIKKO

Nikko, called by one writer "the climax of Japanese wonders," lies in the midst of the "Mountains of the Sun's Brightness." It is noted not only for its glorious scenery, especially in November, but also for its shrines, its wood-carving and painting. The total number of men employed daily for 12 years in building and decorating the shrines is supposed to have been about 15,000.

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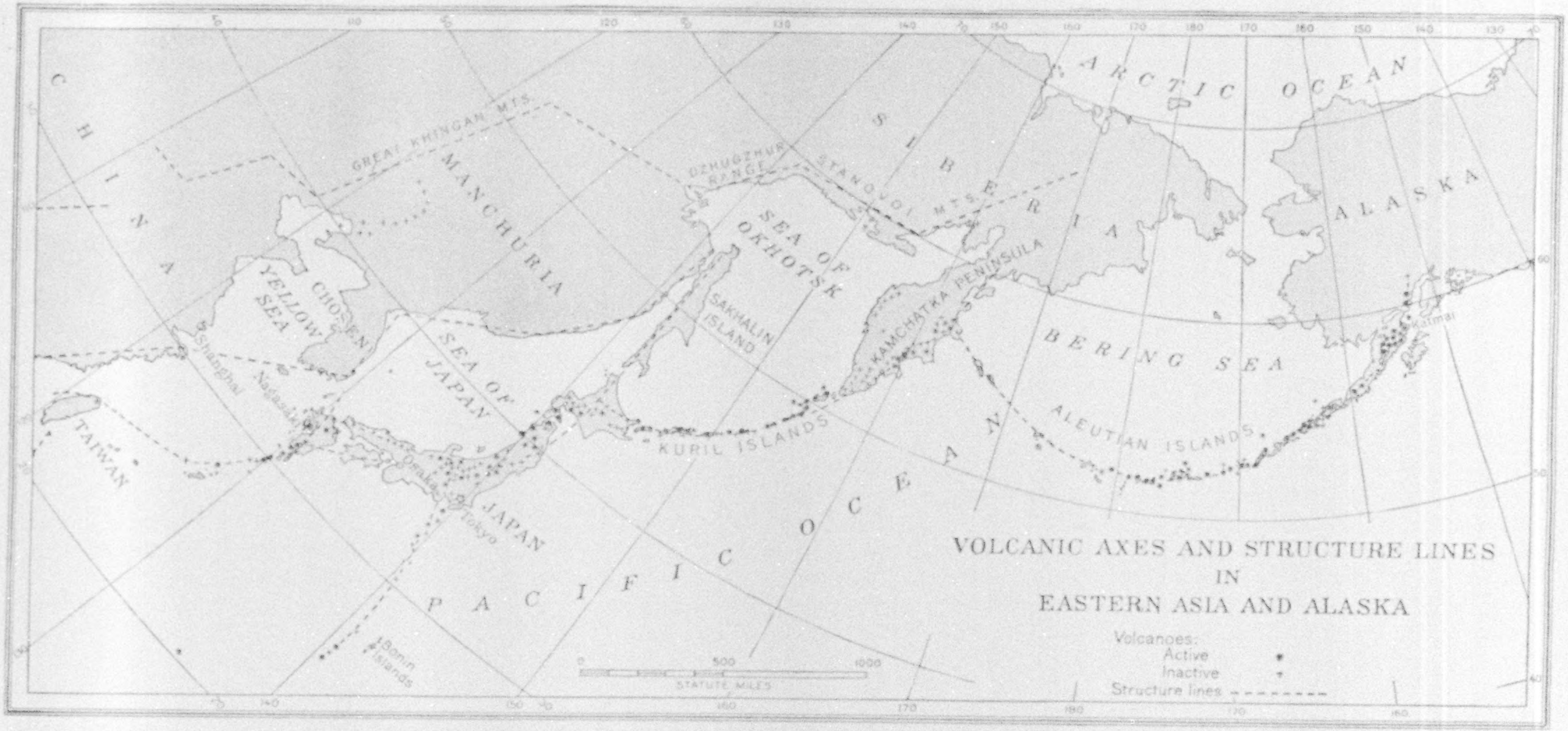
VOLCANIC AXES AND STRUCTURE LINES
IN
EASTERN ASIA AND ALASKA
Volcanoes:
Active
Inactive
Structure lines
ARCTIC OCEAN
ALASKA
SIBERIA
BERING SEA
ALEUTIAN ISLANDS
Katmai
KAMCHATKA PENINSULA
SEA OF OKHOTSK
SAKHALIN ISLAND
KURIL ISLANDS
DZHUGZHUR RANGE
STANOVOI MTS.
GREAT KHINGAN MTS.
MANCHURIA
CHINA
CHOSEN
YELLOW SEA
SEA OF JAPAN
JAPAN
Shanghai
Nagasaki
Osaka
Tokyo
Bonin Islands
TAIWAN
PACIFIC OCEAN
0
500
1000
STATUTE MILES

Reproduced from the National Geographic Society's Publication, "The Valley of Ten Thousand Smokes"

MAP SHOWING WHY JAPAN IS SUBJECT TO FREQUENT DESTRUCTIVE EARTHQUAKES

Japan is not only the scene of many earthquakes, but the island kingdom is literally "peppered" with active and inactive volcanoes (indicated respectively by stars and crosses). Yet volcanic eruptions and earthquakes are not interdependent. The quakes caused by volcanic disturbance, while sometimes of extreme violence, are seldom if ever widespread. It is significant to note that more than half of all the earthquakes that have occurred in Japan since careful records have been kept have originated in the ocean deep to the east of the islands.

The crust of the earth is much wrinkled and broken, and the folding and faulting (see page 443) accompanying this process are greatest along the boundary lines between elevated and depressed segments, developing cracks. Such folding is seen in the curving mountain ranges of Japan, while offshore is one of the deepest "deeps" in the whole ocean, suggesting that one block of the crust has slipped over the next and pushed it down. Next outside the island festoons of Japan is the scalloped coast line itself. Beyond that is another series, including the remarkable escarpment of eastern Manchuria—the Great Khingan Mountains, the dominating geographic feature of the entire region.

motion of the solid floor is very slight, but the marble, because it is free to move, is propelled a considerable distance.

Similarly, a quick earth tremor of very small dimensions may heave loose rocks or other equally heavy objects many feet from their original positions. The same circumstance explains the very much greater destructiveness of earthquakes on alluvial soil, whose particles are easily broken loose, than on solid rock. The disruption of the earth's surface by the Kansu quake of 1920, which occurred in the loess district of China, where loose, porous soil extends for several hundred feet below the surface, was, perhaps, greater than in any other known earthquake. The affected region was well described by the Chinese as the "land where the mountains walked." *

The fact that both Tokyo and Yokohama were built on loose alluvium undoubtedly greatly increased the destructiveness of the recent terrible cataclysm.

TIDAL WAVES

In many earthquakes the greatest destruction is wrought by tremendous inundations, which sweep over the land like abnormally high tides, rising 10, 20, 30, or even, in exceptional cases, 50 feet above any previous tide-mark.

The terror occasioned by these terrible floods is so overwhelming and they leave so few survivors to tell the tale that accurate accounts of events are seldom to be had.† One of the most lucid descriptions of such a wave is given by Darwin in the "Voyage of the *Beagle*," chapter 14: "The disturbance seems generally, as in the case of Concepcion, to have been of two kinds: first, at the instant of the shock, the water swells high up on the beach with a gentle motion, and then as quietly retreats; secondly, some time afterwards, the whole body of the sea retires from the coast, and then returns in waves of overwhelming force. . . .

"Shortly after the shock, a great wave was seen from the distance of three or four miles, approaching in the middle of the bay with a smooth outline; but along the shore it tore up cottages and trees, as it swept onwards with irresistible force. At the head of the bay it broke in a fearful line of white breakers, which rushed up to a height of 23 vertical feet above the highest spring-tides.

"Their force must have been prodigious; for at the fort a cannon with its carriage, estimated at four tons in weight, was moved 15 feet inwards. A schooner was left in the midst of the ruins, 200 yards from the beach.

"The first wave was followed by two others, which in their retreat carried away a vast wreck of floating objects. In one part of the bay a ship was pitched high and dry on shore, was carried off, again driven on shore, and again carried off. In another part two large vessels anchored near together were whirled about and their cables were thrice wound around each other; though anchored at a depth of 36 feet, they were for some minutes aground.

"The great wave must have traveled slowly, for the inhabitants of Talcahuano had time to run up the hills behind the town; and some sailors pulled out seaward, trusting successfully to their boat riding securely over the swell, if they could reach it before it broke."

Yet by no means all earthquakes along the sea involve tidal waves. In Kingston, Jamaica, the earthquake of January 14, 1907, resulted in the settling of the harbor bottom as much as 27 feet in places, but there was no tidal wave.

The reports of the present Japanese disaster have repeatedly spoken of damage by tidal waves, but at this writing it is not clear how great a share they may have had in the destruction.

EARTHQUAKES NOT CLOSELY CONNECTED WITH ERUPTIONS

It is often supposed that earthquakes are closely related to volcanic eruption, and in the present disaster there have been not a few rumors of the explosion of an unnamed volcano somewhere "in the vicinity."

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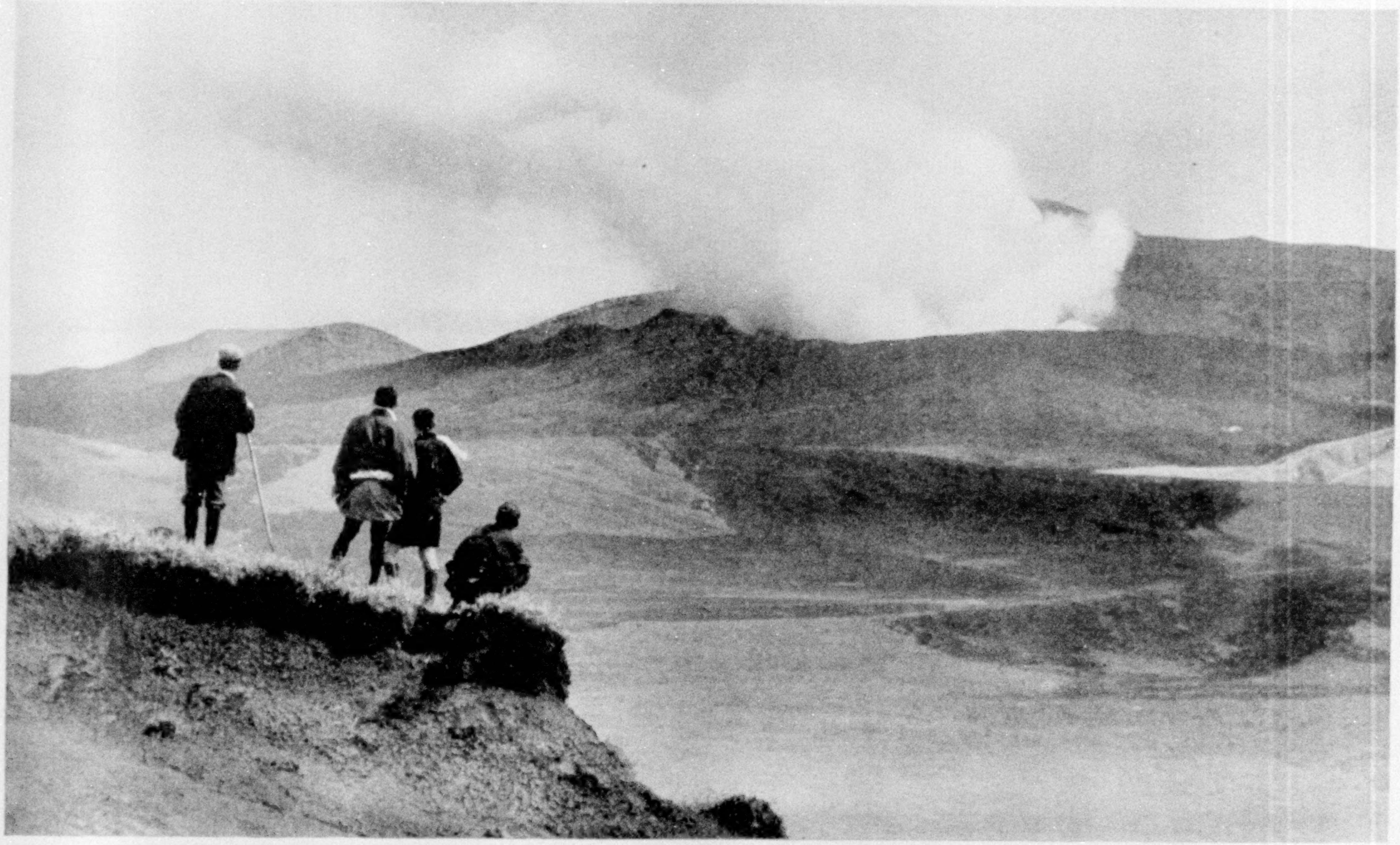
* See "Where the Mountains Walked," by Upton Close and Elsie McCormick, in the NATIONAL GEOGRAPHIC MAGAZINE for May, 1922.

†A remarkable personal experience on a United States gunboat, which was carried by a tidal wave unharmed two miles inland, is given by Rear Admiral L. G. Billings in his article, "Some Personal Experiences with Earthquakes," in the NATIONAL GEOGRAPHIC MAGAZINE for January, 1915.



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STEAMING ASO-SAN, ONE OF JAPAN'S FIFTY-ONE ACTIVE VOLCANOES

The fissure from which the steams of Aso-san pour lies in the floor of a giant extinct crater in the east-central part of Kyushu, 5,630 feet above sea-level. It belongs to the mountain range known as the "Japanese Alps," in the center of the main island.

This supposition is natural enough, in view of the fact that many earthquake belts are situated near active volcanoes.* But a study of the great earthquakes of history refutes this idea.

The idea of the interdependence of volcanoes and earthquakes was indeed first negatived in Japan itself by the work of Milne, the great pioneer student of earthquakes. As a result of careful studies of the locations of earthquakes, he concluded: "The central portions of Japan, where there is a considerable number of volcanoes, are singularly free from earthquakes. The greater number of disturbances originate along the eastern coast of the empire, and many of these have a submarine origin." †

Concerning this point, Omori recently remarked:‡ "A volcanic district may be assumed to be free from the visitation of a great destructive earthquake whose area is extensive and whose intensity is sufficient to destroy properly constructed wood or iron buildings."

Nevertheless, it is recognized that both volcanic chains and earthquake belts occur in regions where the earth's crust is unstable. They are to be looked on in part as independent manifestations of the same underlying conditions.

Volcanic disturbances indeed often produce earthquakes of extreme violence, though their effects are seldom, if ever, widespread. Such a series of earthquakes culminated on Mauna Loa, in Hawaii, on April 2, 1868. For six days after the beginning they gradually increased in power until the final shock was so violent that neither man nor animals could stand against it. At times, indeed, it was necessary for the prostrate figures to stretch out their arms to avoid being rolled over and over. Almost every sort of man-made structure was demolished in the region of greatest severity. But the area affected was astonishingly small—75 miles away no damage was done.

Contrast with this local quake the recent disaster in Japan, which spread 140 miles up and down the coast and 100 miles inland, though the center of the disturbance is said to have been far off shore. The very restricted effect of volcanic quakes is probably due to the fact that their disturbance is centered at a single point comparatively near the surface of the earth, while a fault line may extend for hundreds of miles and reach to profound depths.

VOLCANIC QUAKES BEGIN GENTLY; FAULTING OCCURS SUDDENLY

Another striking difference between the quakes accompanying a volcanic eruption and those due to a great slip in the rocks should be noted. The volcanic quakes begin with gentle quivers and increase to the climax only gradually, during a period of days or weeks; but in faulting the great destructive shake usually comes without warning, and the later shocks which follow in its train are of reduced violence, as though minor readjustments consequent upon the great slip were being made, until finally quiet returns.

Thus, in the Assam earthquake of 1897, which is considered by many authorities preëminent among modern earthquakes, everything was destroyed in the first 15 seconds and the heavy shocks all occurred within two and a half minutes. To this rule the recent shock was no exception. The after-shocks, as reported by the Imperial Earthquake Observatory, numbered 356 on the first and second days, 289 on the third, 173 on the fourth, 148 on the fifth, and 63 on the sixth day.

As is well known, the crust of the earth is much wrinkled and broken, as though a stiff rind were adjusting itself to a shrinking interior. The folding and faulting accompanying this process is naturally greatest along the boundary lines between elevated and depressed segments. And this is precisely the position of Japan.

The depression of any segment of the earth's crust is sure to develop surface cracks of two sorts—circular cracks around the center of depression and radial cracks stretching away from it.

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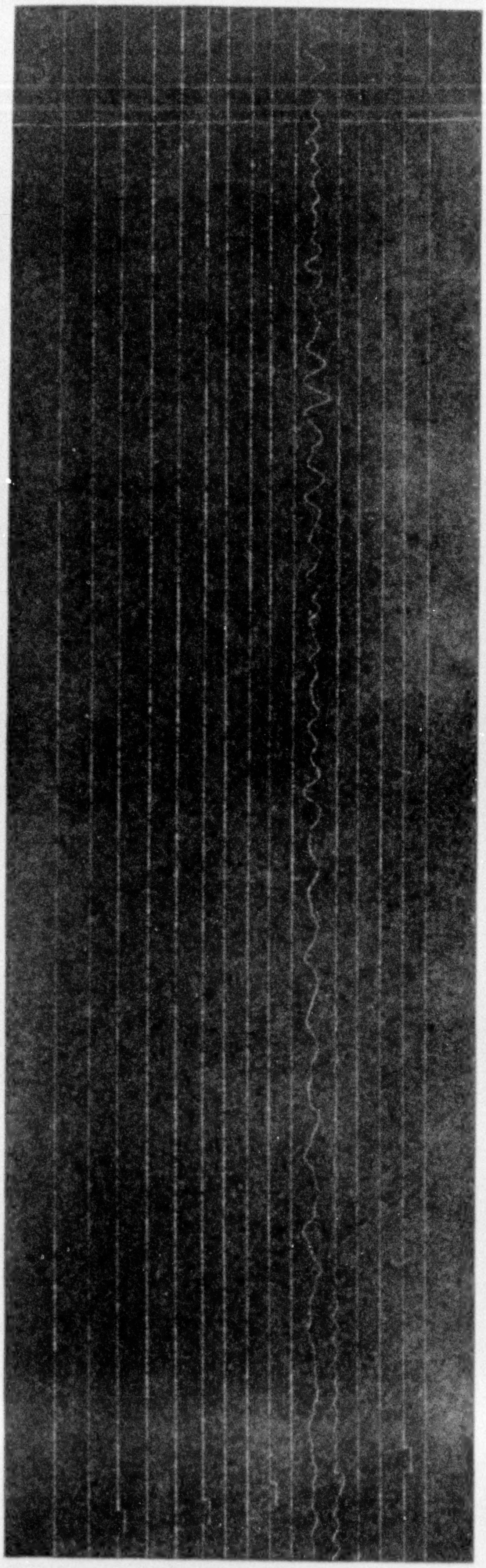
* See also, in the NATIONAL GEOGRAPHIC MAGAZINE, "Costa Rica—Vulcan's Smithy," by H. Pittier, June, 1910; "The Shattered Capitals of Central America," by Herbert J. Spinden, September, 1919; "The World's Most Cruel Earthquake" (Messina), by Charles W. Wright, April, 1909, and articles on the Mont Pelée eruption and Martinique disaster in the issues for June, 1902, July, 1902, December, 1902, November, 1903, and August, 1906.

† Seismological Journal of Japan, 1895, p. 16.

‡ Bulletin, Imperial Earthquake Investigation Committee of Japan, volume 11, March, 1923, page 32.



THE SEISMOGRAPH'S "SHORT-HAND" MESSAGE, WRITTEN AT THE GEORGETOWN UNIVERSITY LABORATORY, RECORDING THE DESTRUCTION OF TOKYO AND YOKOHAMA ON SEPTEMBER 1, 1923

The earthquake instrument traces its awesome message by means of a tiny platinum point running over a sheet of smoked paper. This paper runs continuously. The right-angle "jogs" in the lines indicate hours; one of these lines from left to right represents approximately 17 minutes. When no appreciable quake is occurring the platinum point traces a smooth line, hour after hour. When a quake comes the line wavers. When Father Tondorf first examined this record he had to study it at arm's-length lest his breath blow the soot over the thin line; his calculation of the distance of the quake was 6,500 miles. Fifteen minutes later, when the smoke-sensitized sheet had been shellacked and he could study it more minutely, he computed the center of the disturbance as in Japan, 6,300 miles from Washington, which proved to be correct. This estimate was given out in Washington three hours before any direct news of an earthquake in Japan had been received (see text, page 453).

Figures of this sort are familiar to every skater who has observed the cracking of thin rubber ice, as it slowly gives under too heavy a load. If now we imagine the strain to which the ice is subjected, complicated by side pressure toward the depression, we can see that the circular cracks would be bent inward, becoming convex instead of concave on the outside; and if there were a series of pressures against the edge of such a system of cracks, its margin would become a series of scallops.

A glance at the map (see page 446) shows exactly such a series of scallops along the eastern coast of Asia. Beginning at the north, there are: the Aleutians, Kamchatka and the Kuril Islands, Sakhalin and Japan, Chosen and the Lu-Chu Islands, and Formosa (Taiwan). Each of these axes is convex seaward, and there is in many places clear evidence, in the trend of volcanic chains and in the courses of the fault lines, of double systems of tangential and radial fissures like those in the fractured ice.

We can see further, in our imagined system of ice cracks, that inward pressure on the edge of the sinking area would tend to close up the circular cracks and change them into folds if the crust were flexible enough, or to break them apart and shove the outer over the edges of the inner, either process resulting in shortening the crust and compensating for the lateral pressure.

This is what has happened in eastern Asia. The folding is seen in the curving mountain ranges of Japan, while offshore is one of the deepest "deeps" in the whole ocean, suggesting that one block of the crust—that which carries the Island of Japan—has actually slipped over the next and by its weight pushed it down.

It is significant to note that more than half of all the earthquakes that have occurred in Japan since the beginning of careful records have originated in this deep to the east of the islands. It is as though the two overlapping segments of the crust were sliding on each other under the seaward thrust from the continent.

Just as breaking ice shows a number of circular cracks, one outside the other, so eastern Asia shows several rows of scallops.

In addition to these major fracture lines, there are many lesser ones, incompletely known as yet, but all falling into line with the greater ones. All of these lines, both great and small, are similar in structure and show upon examination that they were produced by the crowding of the continent of Asia toward the Pacific.

JAPAN WAS AMONG FIRST COUNTRIES TO STUDY EARTHQUAKES

So extended a discussion of the structure of eastern Asia may seem far afield from the single earthquake which has visited Tokyo, but this disaster can in nowise be considered an isolated event. It is merely one shock of unusual violence in a region where the ground is never quiet for long at a time. On the average, nearly 1,500 earthquakes every year—four a day—occur in Japan.

Recognizing the inevitable earthquake danger, the Japanese Government early saw the importance of the study of earthquakes, and has long led the world in this branch of science, excelling in the exactness and length of its records of past earthquakes, in the application of the latest discoveries of science to earthquake investigation, and in practical measures to minimize earthquake damage. The Imperial Earthquake Investigation Committee has devised buildings designed to withstand earthquakes. The frame houses recommended have many diagonal timbers, which tie the whole structure together into a single unit, so that it will resist the shock like a ship beaten about by the waves.

An earthquake-proof brick building is more difficult. Most people would feel that a brick building was necessarily a bad earthquake risk, but the Earthquake Investigation Committee has undertaken to prove the contrary. A brick building was constructed in Tokyo which this Committee declared "will stand any shock likely to occur in Tokyo and will serve as a standard with which to compare the effects of a shock on ordinary brick buildings."

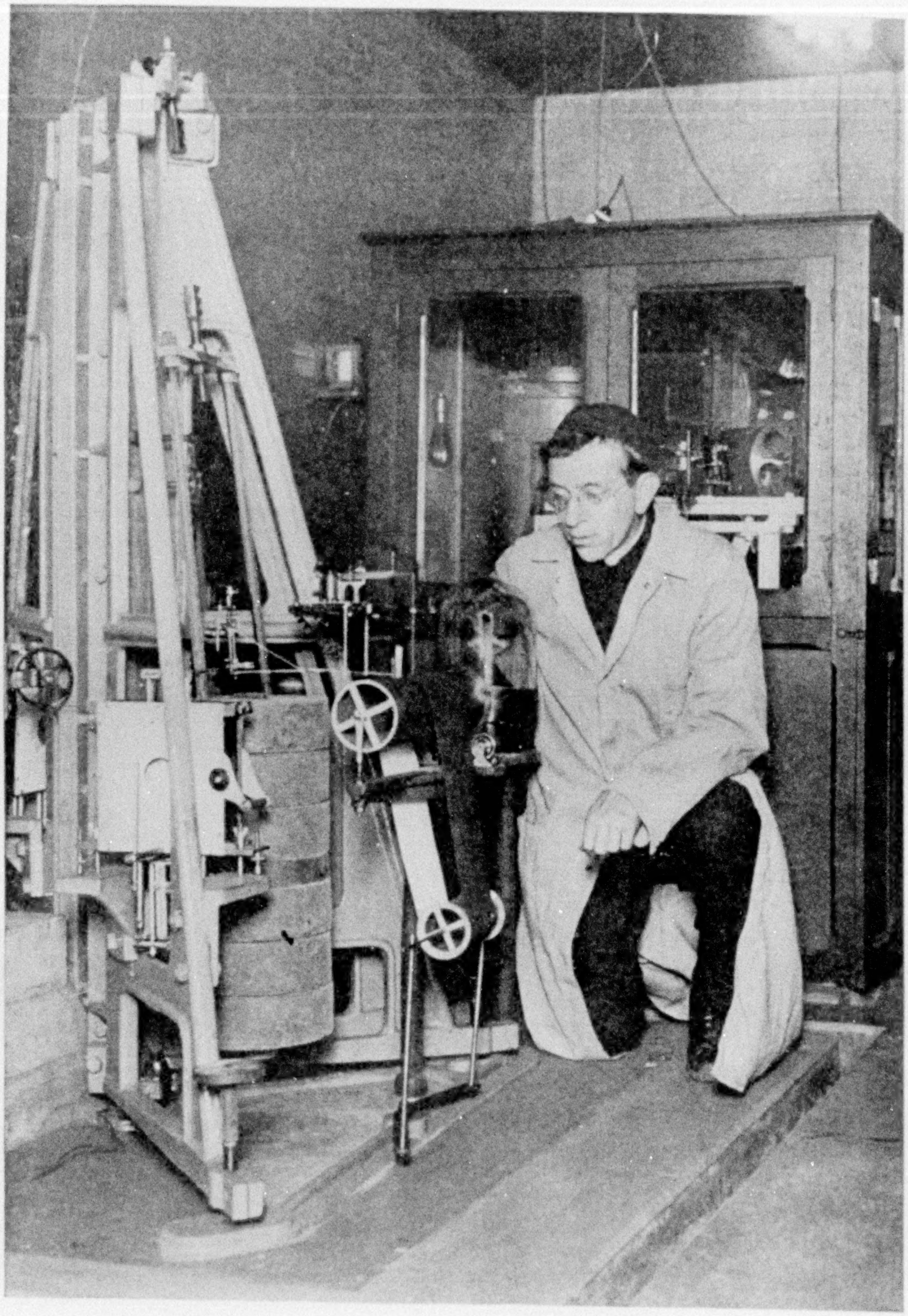
The Committee showed faith in its conclusions, moreover, by housing its seismographs and other instruments in this building. As the press reports immediately following the disaster have given frequent reports from this observatory, it may be inferred that it withstood the shock and justified the Committee's confidence.

The essential principle in its construction was learned from experiments with brick columns on a "shaking table," made to simulate earthquake shocks. Here it was observed that the columns always broke close to the base.

The walls, therefore, were built very thick at the base, tapering upward in a parabolic curve, which investigation had shown to give equal strength throughout the height. The roof, instead of being built into the walls, rested loosely on them, to permit free movement.

It will be interesting and instructive, as detailed reports of the disaster come in, to see how far the recommendations of the Committee were carried out, and how far the precautions suggested went toward reducing the destruction.

We may be sure, however, whatever fuller information may disclose as to the success of the Committee in modifying the buildings of an old city, that when Tokyo is rebuilt these findings will be incorporated in the building code in a way to insure against a repetition of the disaster.



FATHER TONDORF IN THE GEORGETOWN UNIVERSITY SEISMOLOGICAL LABORATORY

In the center of the picture may be seen the band of smoked paper on which the platinum needle inscribes its message of disaster wherever it may occur (see illustration, page 450). Theoretically, the platinum point is so balanced and counterbalanced as always to remain stationary; the smoked ribbon sways with the earth, which is elastic and transmits every quake, however distant.

HOW THE EARTH TELEGRAPHED ITS TOKYO QUAKE TO WASHINGTON

By the Rev. Francis A. Tondorf, S. J.

Director Seismological Laboratory, Georgetown University

THAT wisdom ripens white with the early hours and may be had for the gleaning only, is an aphorism which has ever been a favorite saying of parent to child. Æschylus, Greek poet, had sung some two thousand years ago that "it is never too late for the old man to learn his lesson"; and so with my early visit, on the morning of the first of September, to the cave which houses the seismographs of the Georgetown University Seismological Station, I was made wise, among the first, if not the first, in the United States, that the proverbial earth-spider of the Japanese had reared his back against the mighty columns that brace the floor of the Isle of Japan, thuswise rocking its superstructures to their very foundation stones.

On removing the sheets from the sensitive detectors, known as seismographs, and suitably mounting them, these were ready for closer inspection. The groundscripts of Mother Earth bespoke, apart from any measurement, one long, weird message of possible destruction on land or sea afar off.

Certain it now was that the inscribed quake was not of volcanic origin, for these are rarely severe, never widefelt, and always beyond the reach of the distant telltale. So the conclusion was warranted that a displacement had taken place in the cupola of the globe, and this necessarily in an area abutting some seam of weakness.

Fortunately, the seismogram was strikingly distinct, and so the estimate of the distance a matter of a minute's calculation. Strangely enough, Mother Earth has an efficient corps of heralds, ready at a second's notice to dispatch her messages of disaster to every corner of the globe. Onward they wing their way under the disguise of elastic waves, one with a velocity of 800 kilometers (497 miles), the other with 450 kilometers (279½ miles) per minute. The time-lag, when measurable at their destination, forms the basis of computation.

Whoever could solve the problem of the distance between Washington and New York, given the time of arrival of two trains that had left Washington simultaneously and traveled with different speeds along parallel tracks, would rob seismology of much mystery.

LOCATING THE EARTHQUAKE IN JAPAN

The first alarm was sounded in Washington at twelve minutes after 10 o'clock p. m., eastern standard time, and the second approximately eleven minutes after, the distance accordingly totaling to 6,300 miles. Such was the estimate furnished to the Associated Press and sent out over its wires three hours before any word of disaster had reached Washington.

Take a reliable map, apply this distance, and you will be convinced that the seismograph has something to do and does it.

Mark Twain it was, I think, who said that he found it easy to see how the astronomer could figure the distances of the stars, but that he could not see how they read their names with the telescopes.

Maybe the wonder grows how the seismologist can spell the location from the queer etchings of the white on black of the seismogram. Nor can he, at least not scientifically, if the gram of a single observatory is all that is to hand.

The old herb doctor learned the proper treatment of disease by trying out plant juices on the other fellow. Elimination has taught the wisest of Solomons a great deal. Then, is it a crime for the seismographer, when science fails him, to turn his back on a recreant teacher and try elimination? That is not guessing.

How do we do it?

With the seismographic station as a center, we draw a ring with a radius equal to the computed distance and we have lopped off a mighty big portion of the 196,940,400 square miles of the earth's surface where the quake did *not* happen. That's something.

Then we keep to the one-rail trolley, noting the stations along the route with

XUM

a seismological guidebook within seeing, read off the seismic zones, and if we find only one, why we've got it.

And so we learned of the quake in Japan.

Had we any prejudices against this method of elimination, we might have very readily suppressed them in the present instance, for Dr. F. Omori, member of the Imperial Earthquake Investigation Committee and director of the Tokyo Seismic Observatory, the foremost authority to-day in earthquake researches, predicted in 1921 that within six years of that date there would occur a cataclysm. This faithful old Achates had kept a watchful eye "every day and in every way" on those tiny earth rockings which had kept the Mongolian nurse, sentry over the infant cradle, from striking for shorter hours and higher wages.

Omori noticed—I quote his own words—that for an earthquake district like Tokyo and the neighboring provinces, the frequent occurrences of *ordinary* small earthquakes may be regarded as maintaining the portion of the earth's crust concerned in a state of normalcy, removing so often the underground weak points, thereby preventing the production of a strong earthquake. On the other hand, a low seismic frequency must cause an accumulation of telluric stress, and consequently is likely to be followed by a seismic disturbance of a large magnitude.

Catastrophes on June 20, 1894, October 15, 1884, and March 31, 1909, had closely followed in the wake of such frequency minima. Then, with voice prophetic, he warns that, as during the last nineteen years the frequency variation indicated a period of six years, we may expect the repetition of a disturbance similar to that of the recent earthquake in some six years, and another at the end of a further interval of some six years.

The Japanese have had no monopoly on such forecasts. Californians had them from resident geologists some days preceding the San Francisco quake. Both communities seemed to have failed to profit by them. Confidence in the seismologist has not yet reached its optimum. It will, *errando discimus*. With an average occurrence of an earth shock every two hours and twenty-seven minutes, the chances of error are not few.

"Children should be seen, not heard," is an interdict dating back to Cain and Abel. Seismologists, alias Benjamins in science, apparently fall under the ban. Realizing this, you find them timidly advancing their theories with a "perhaps," "not unlikely," "possibly," etc.

SEISMOLOGY, ONE OF THE YOUNGEST OF SCIENCES, PRESENTS ITS "PERHAPS"

With apologies to the Nestors in science and with the footnote that the Planets are far too big to be narrowed down into the small margin of the brain, the following summary of data regarding the recent catastrophe is suggested as possible:

The quake was undoubtedly due to a slipping in the earth's crust following an abnormal underground stress accumulation.

The origin was some distance from Tokyo.

Seismic activity in Tokyo Bay, as a compensation to the less recent activity in the mountainous districts, was at least a contributing cause.

That "a great break in the ocean's bottom" was the cause of the quake, as expressed by an American geologist in an interview with a news agency, is questionable; for since the destructive quake of 1854 the ocean's bed has been remarkably quiet and some years will intervene before such activity may be resumed. Even under those conditions, Omori is of the mind that Tokyo will not suffer, but that the disturbance will be experienced farther westward.

Precipitations and barometric variation may be taken as possible secondary causes.

The geophysical conditions on which Omori predicted severe quakes would occur in 1927 and 1933 have been so altered by the recent disaster that these prophecies no longer apply.

Finally, for the consolation of Tokyonians, it may be recalled that never in the history of earthquakes has any one locality suffered a second overwhelming catastrophe within a generation, and the Japanese capital is not likely to be visited by another cataclysm within the lifetime of any of the present survivors.

Time *may* tell us the true story.

SOUP MAKES THE WHOLE MEAL TASTE BETTER

I never shirk legitimate work
Yet I rollick and revel in play.
My partner-in-chief in getting relief
Is the Campbell's I serve every day!

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CONDENSED
TOMATO
SOUP
CAMPBELL SOUP COMPANY
CAMDEN, N.J., U.S.A.

Time to play!

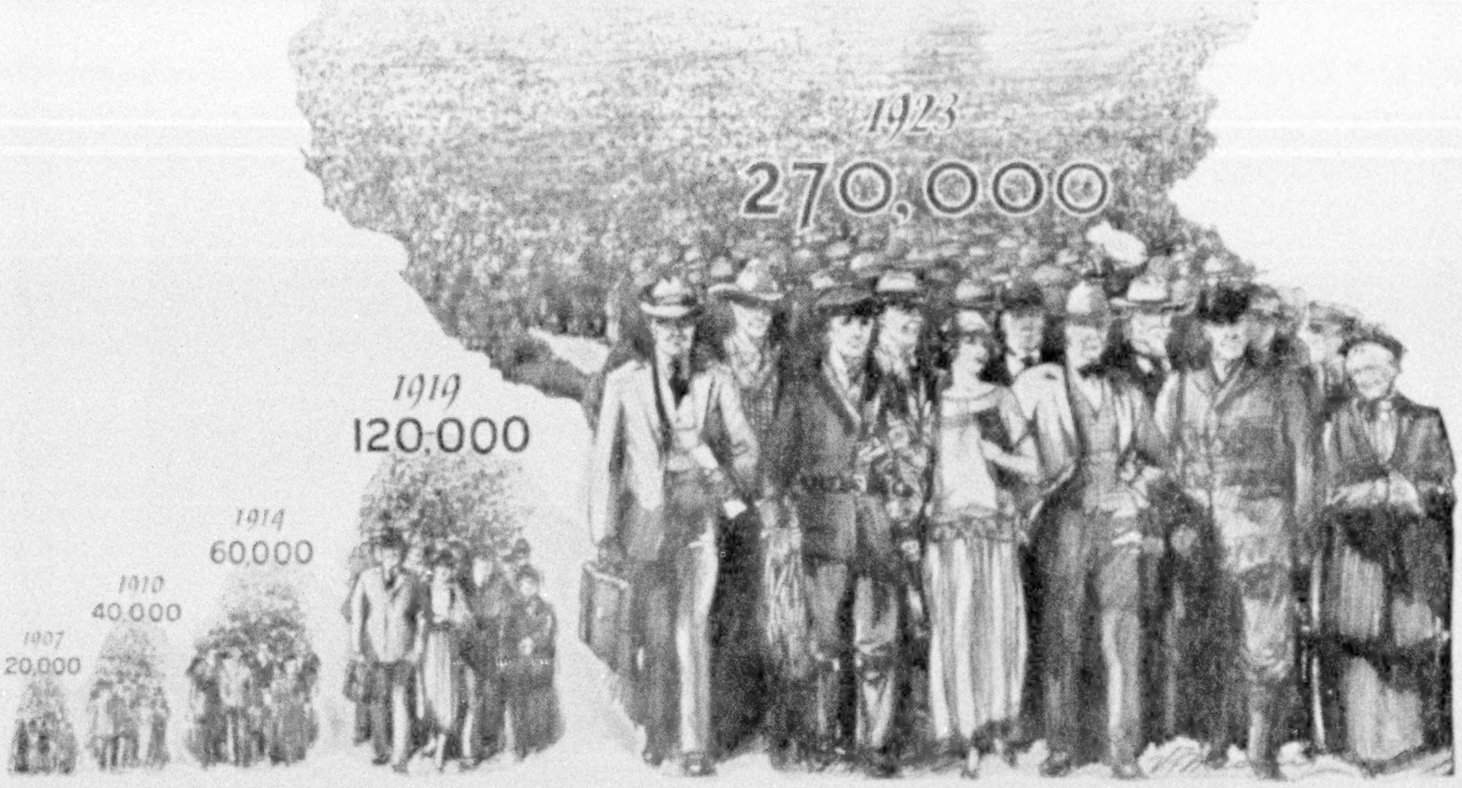
American women have it. Yet they also have the brightest, best-managed, happiest homes in the history of the world. They do it with their brains as well as their hands. And they are just the kind of women who are most grateful to Campbell's for offering the sensible, modern way to "make" soup that is the pride of their tables.

There are millions of these progressive "new housekeepers" who recognize that Campbell's Tomato is the most attractive soup they could place on their tables. Its rich tomato juices, blended with fresh, golden butter and seasoned "to a taste," tempt the appetite and delight the palate. Always ready! Always delicious!

21 kinds **12 cents a can**

Campbell's Soups

LOOK FOR THE RED-AND-WHITE LABEL



These groups of stockholders illustrate the rapid growth in ownership of the Bell System.

A Community of Owners Nation-wide

"Who owns the company?" "What is behind it?" These questions are asked in appraising the soundness of a business and in determining its aims.

The American Telephone and Telegraph Company is owned by more than 270,000 people living in every state in the Union. Could the stockholders of the Bell System be gathered to one place, they would equal the population of a city about the size of Providence or Denver.

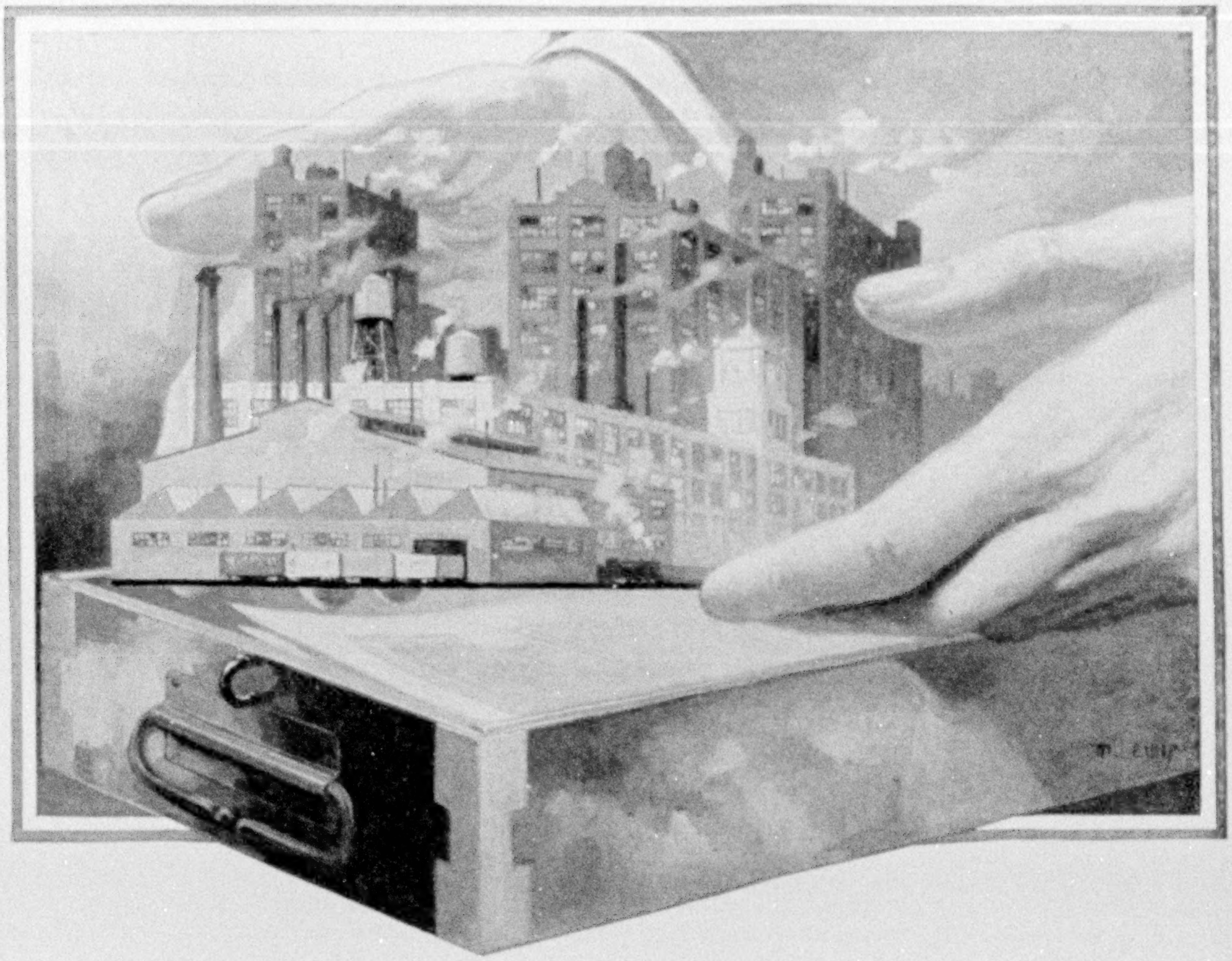
They constitute a representative cross-section of American citizenship. Among them, of course, are bankers and men of large affairs; for the idea of ownership in the Bell System appeals to sound business judgment and a trained sense of values.

In this community of owners are the average man and woman, the storekeeper, the clerk, the salesman, the professional man, the farmer and the housewife—users of the telephone who with their savings have purchased a share in its ownership. The average individual holding is but twenty-six shares.

No institution is more popularly owned than the Bell System, none has its shares distributed more widely. In the truest sense it is owned by those it serves.

"BELL SYSTEM"
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service



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Our branch offices are in the leading cities.

The National City Company

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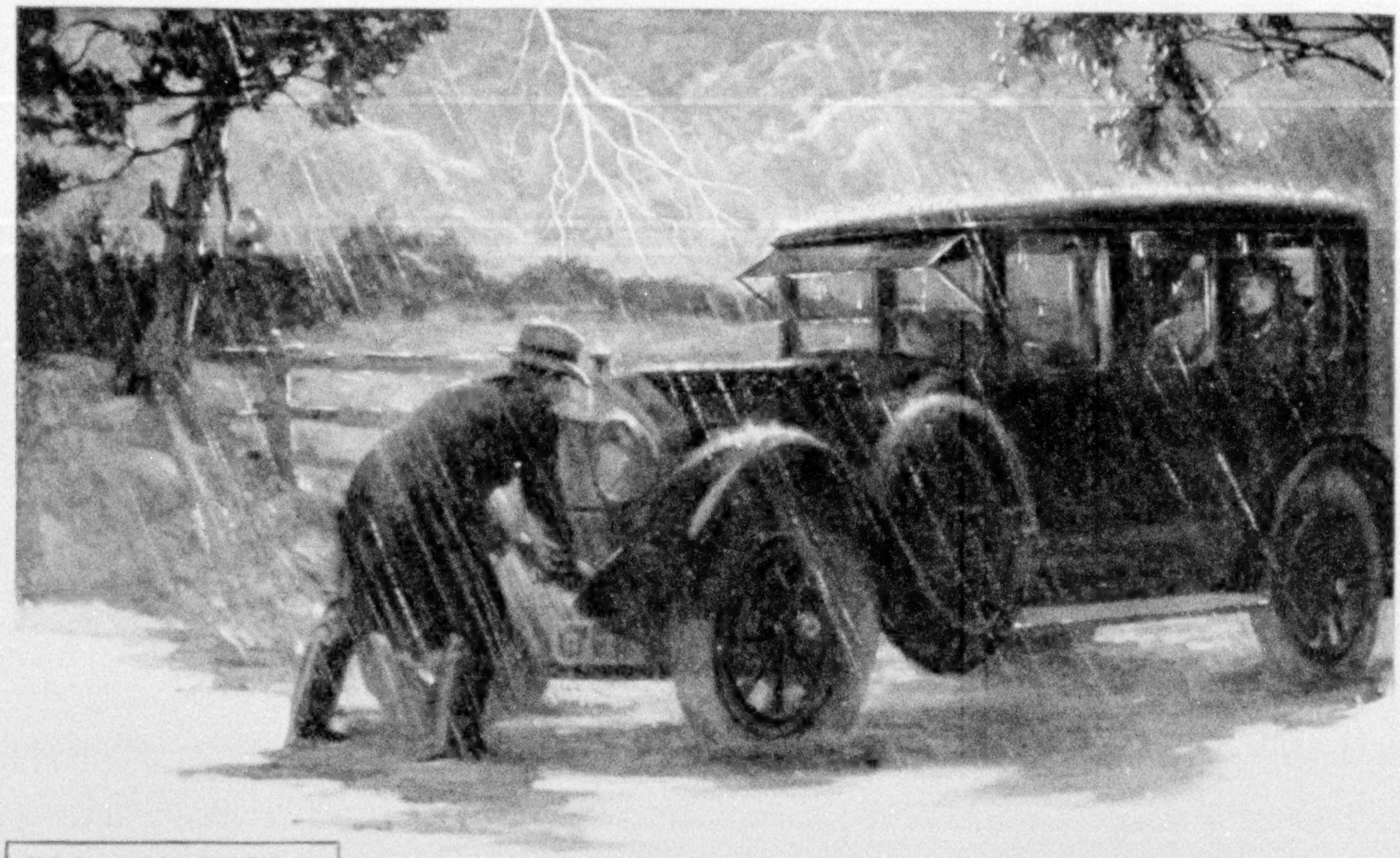
Offices in more than 50 leading cities throughout the World

BONDS SHORT TERM NOTES ACCEPTANCES



This happened to Mr. G. L. M.
—and then HE bought
a Philco

"The night before I got my Philco"

—writes G. L. M., "My old (xxxxx) battery 'passed out' during a heavy storm. Drenched to the skin—mud oozing into my shoe tops—I sloshed and cussed and CRANKED."

Then HE—like thousands upon thousands of car owners—*got his Philco.* A mighty surge of power for quick starts. Sustained power for lights and ignition. Exclusive Philco construction for long-lasting, economical life.

Philco Diamond-Grid Batteries for years have been standard—not only for high power, high capacity, and long life, *but for low cost per month of service.*

Today, the first cost of a full-powered, guaranteed Philco Battery—with its famous Diamond-Grid Plates and other exclusive Philco features—*is actually even less than for just an ordinary battery.*

Install a Philco NOW. Have the assurance of instant, whirling starts—of lavish, unfailing power for brilliant lights, steady ignition, a commanding horn. Your nearest Philco Service Station has the right Philco for your car.

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Philco Batteries are standard also for farm lighting and isolated power services; for radio, electric motor trucks, industrial tractors, mine locomotives and passenger cars; for marine work, auxiliary power, etc. Whatever you use batteries for, write Philco.

Lowest prices in history

A genuine, full-powered guaranteed PHILCO BATTERY

$17.85
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$17.85 is the exchange price east of the Mississippi River for Ford, Chevrolet, Overland, Star and other light cars. Genuine Philco Diamond-Grid Batteries for all other cars proportionately low-priced.

Tremendous increased Philco sales—efficient manufacture—economical distribution—have made these extraordinary reductions now possible.

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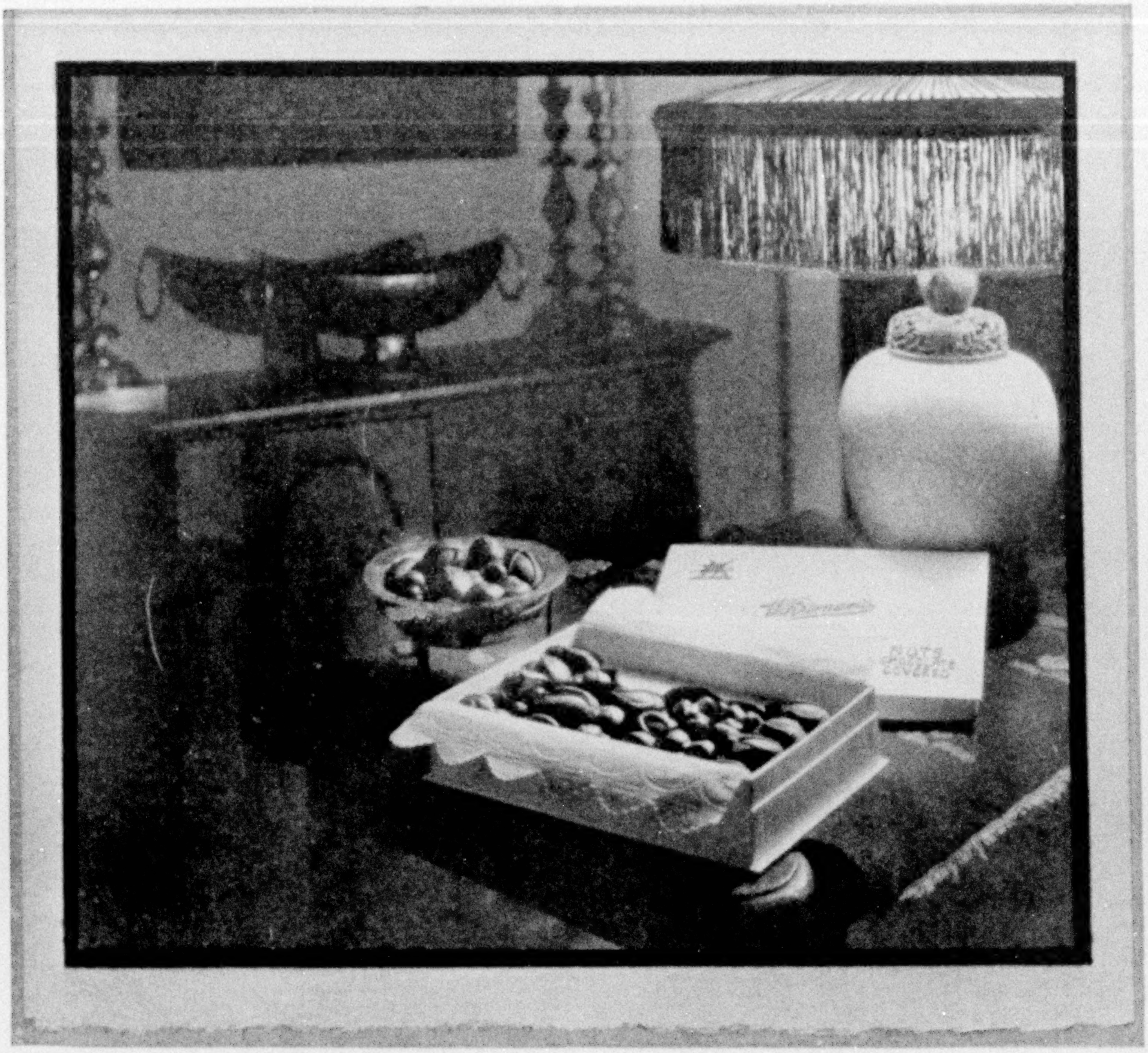
Over 5500 Philco Stations all over the United States. There is one near you. Write for address, if necessary.



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NUTS CHOCOLATE COVERED

A very special appeal to the taste of those who want the best nut meats the markets of the world afford, combined with chocolate of Whitman's Super Extra Quality.

There are no combination centers in this package—nothing but nuts, whole nut meats thickly coated with delicious chocolate.

We believe the kinds are assorted to appeal to most tastes. We know that the package is a first favorite with many good judges of fine confections, and its popularity has increased steadily for many years.

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Filbert Clusters
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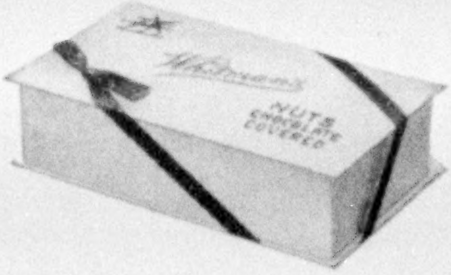

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Nuts Chocolate Covered is one of Whitman's Quality Group of special candy assortments for discriminating lovers of sweets.

This package has a special Hallowe'en wrapper for this holiday.

All Whitman's chocolates are sold only by selected stores in every neighborhood that are chosen as agents for the sale of Whitman's. Every agency receives frequent fresh supplies direct. Every package of Whitman's is guaranteed to be fresh and to give complete satisfaction.

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First Anastigmat lenses cut sharply, clear to the film edge, and thus produce sparkling prints and splendid enlargements.

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The KODAK ANASTIGMATS
f.7.7 *f*.6.3 and *f*.4.5

Eastman Kodak Company
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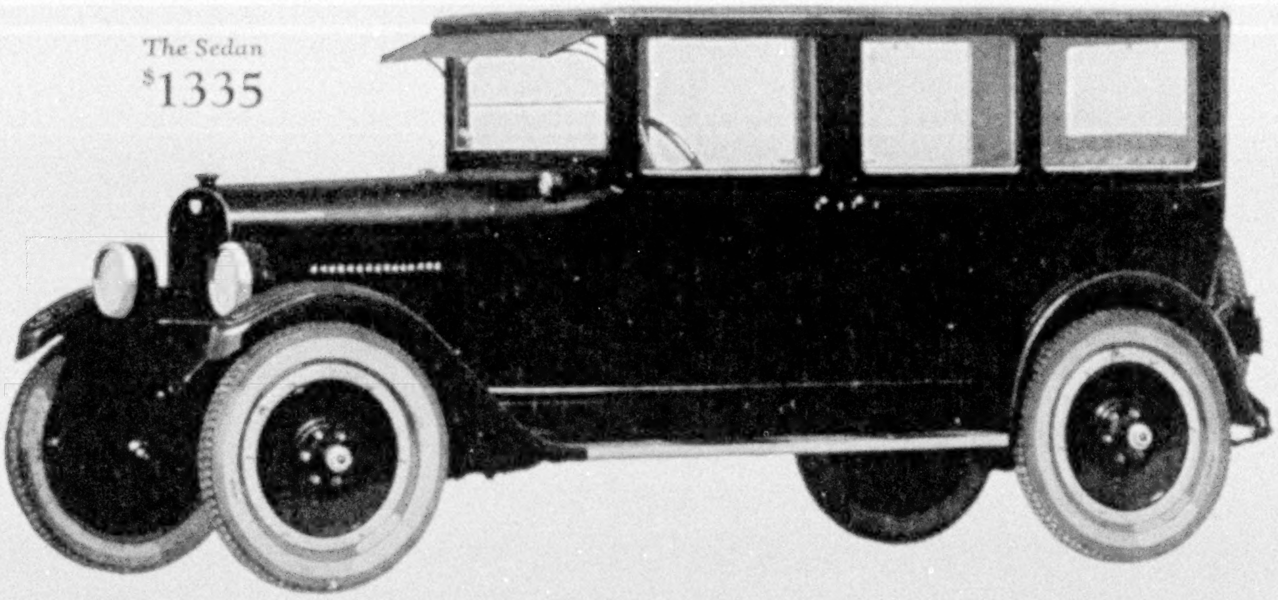
The Sedan
$1335



Here are two cars whose superiority must be so perfectly apparent to anyone who even studies the pictures, to say nothing of the cars themselves, that it seems inconceivable that anything in their price-division can possibly stand up under comparison.

> The wonder of it grows when it is learned that good Maxwell re-sale values are higher all over the United States than anything in their class.
>
> This valuation is established by the dealers in all makes of cars in all parts of the country, in their authoritative reference book entitled National Used Car Market Report.

It is based on the long-lived service, greater economy and superior appearance which are today synonymous with the name of the good Maxwell.

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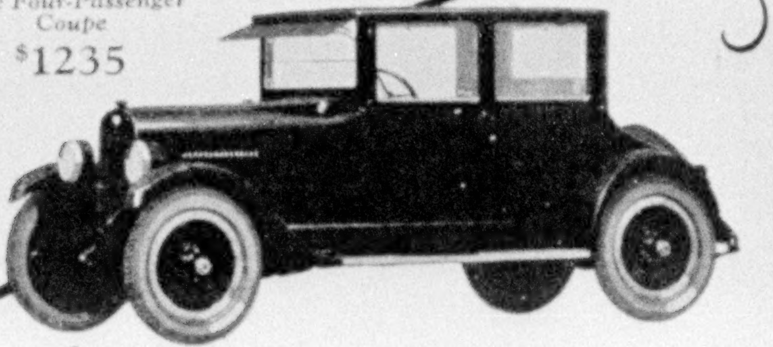
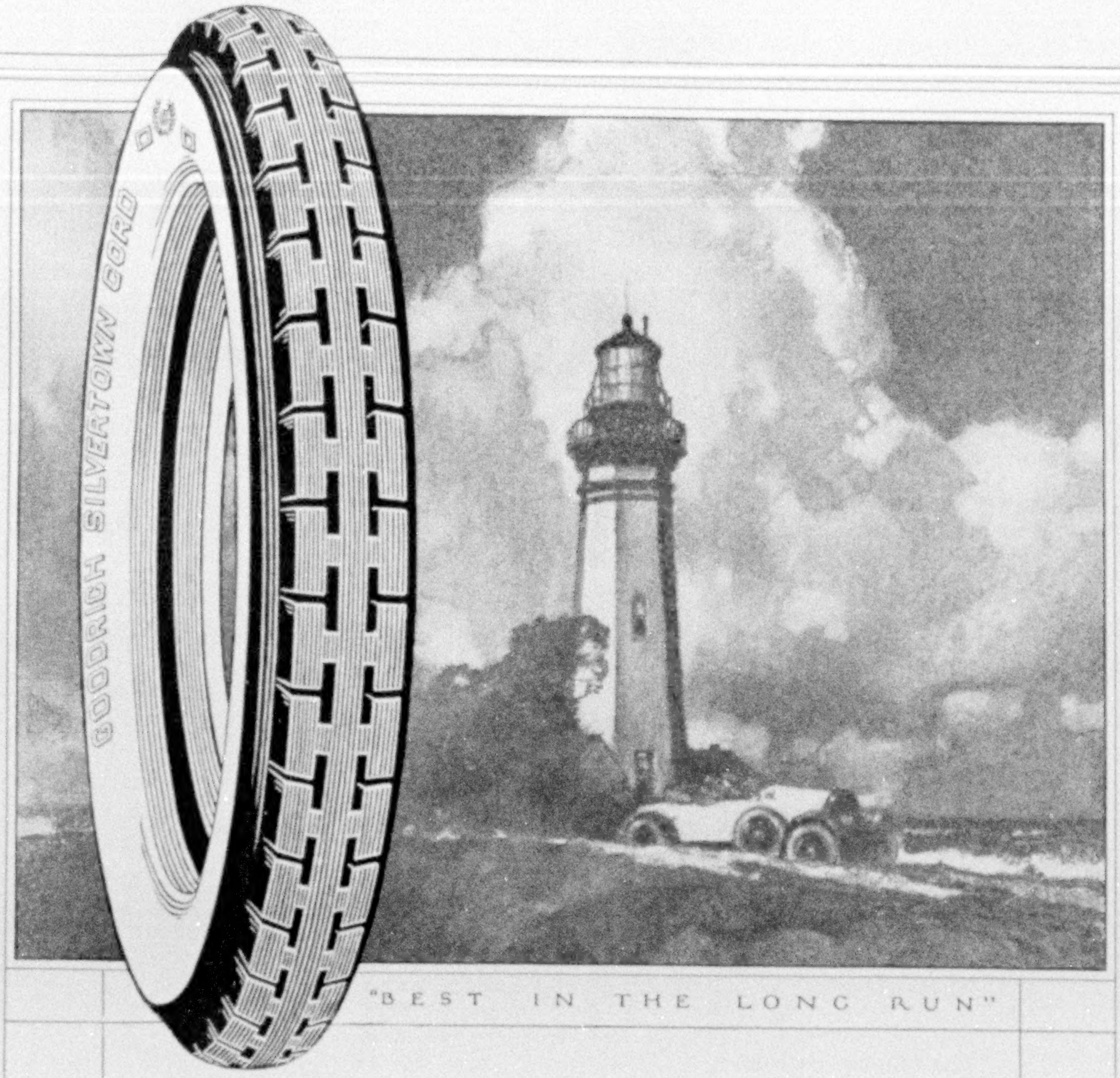
Cord tires, non-skid front and rear; disc steel wheels, demountable at rim and at hub; drum type lamps; pressure chassis lubrication; motor driven electric horn; unusually long springs; new type water-tight windshield. Prices F. O. B. Detroit, revenue tax to be added: Touring, $885; Roadster, $885; Sport Touring, $1025; Special Sport Touring, $1045; Sport Roadster, $975; Club Coupe, $985; Four-Passenger Coupe, $1235; Sedan, $1335.

The Four-Passenger Coupe
$1235



The Good
MAXWELL

XUM



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Do you "Repeat" on your tires?

Do you buy the same make of tire again? Most SILVERTOWN users do; and that's the test of a tire. SILVERTOWN performance, of course, does it. Back of the performance is the sound manufacturing principle of maintained quality. Skill, effort, and care are centered in SILVERTOWN. It comes out in performance and repeats.

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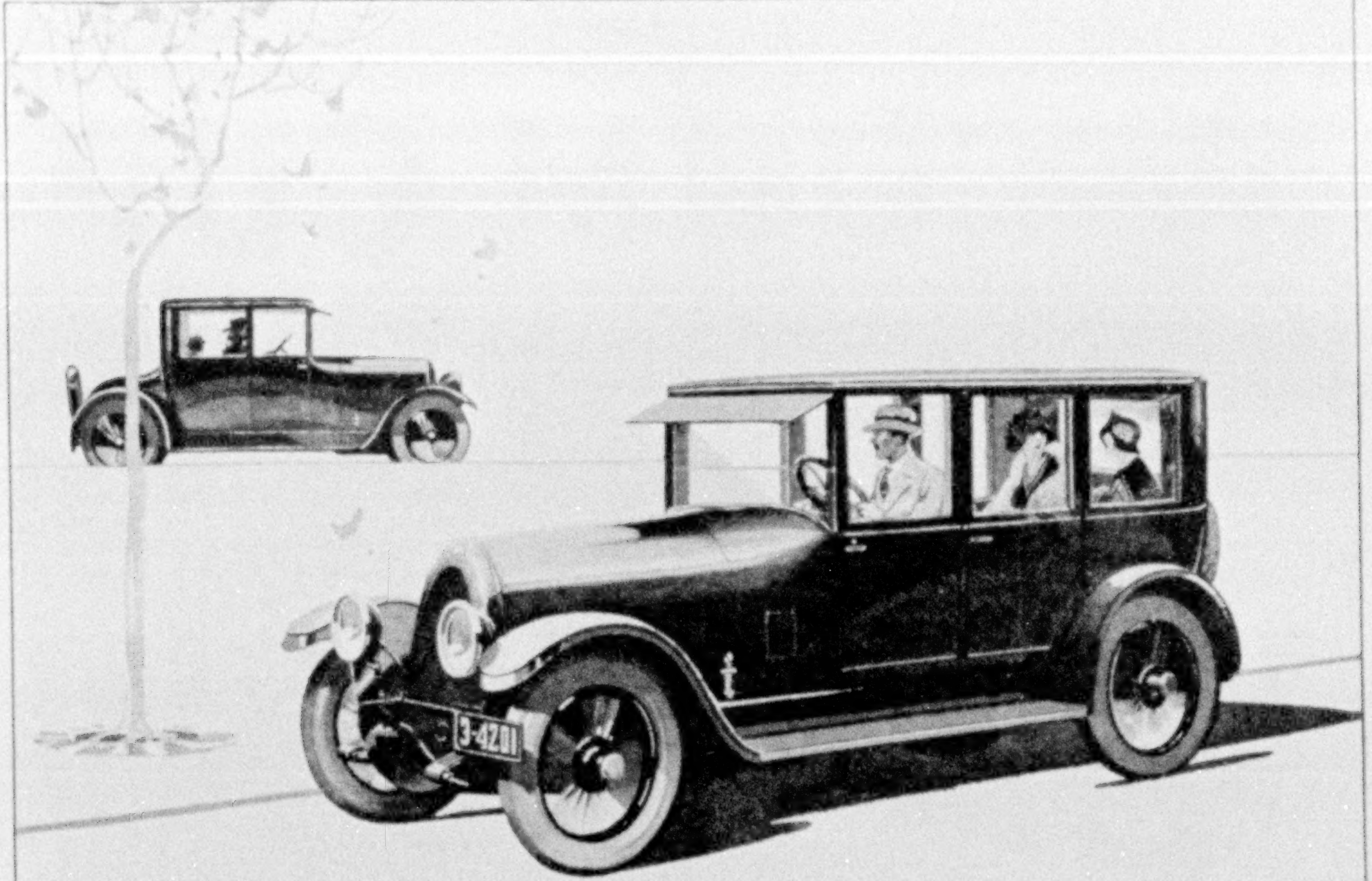

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Franklin sells more closed cars in proportion to total output than any other maker in the world. The percentage is more than double the average of the industry —Franklin, 75%; the industry, 35%.

Franklin closed cars handle easier, ride better, and cover more ground in a day than other closed cars. This difference in road ability is clearly marked by the overwhelming margin of popularity. Perfect cooling under all conditions with the new Franklin air-pressure system.

Powerful New Six Motor
Beautiful Body Designs

The Sedan

A new four-door type, seating five passengers. A great car for touring, and for anyone in the family to drive.

The Coupé

An intimate personal car that seats four when required. Folding auxiliary seat, rear hamper, receptacle back of driver.

The Brougham

A smart, compact car for town and touring, seating five. Wide doors, Pullman front seats, luggage trunk. Finished in Royal Blue.

The Demi-Sedan

Closed car comfort plus open car endurance and performance. Permanent top, leather upholstery, removable sliding windows.

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VACUUM CUP
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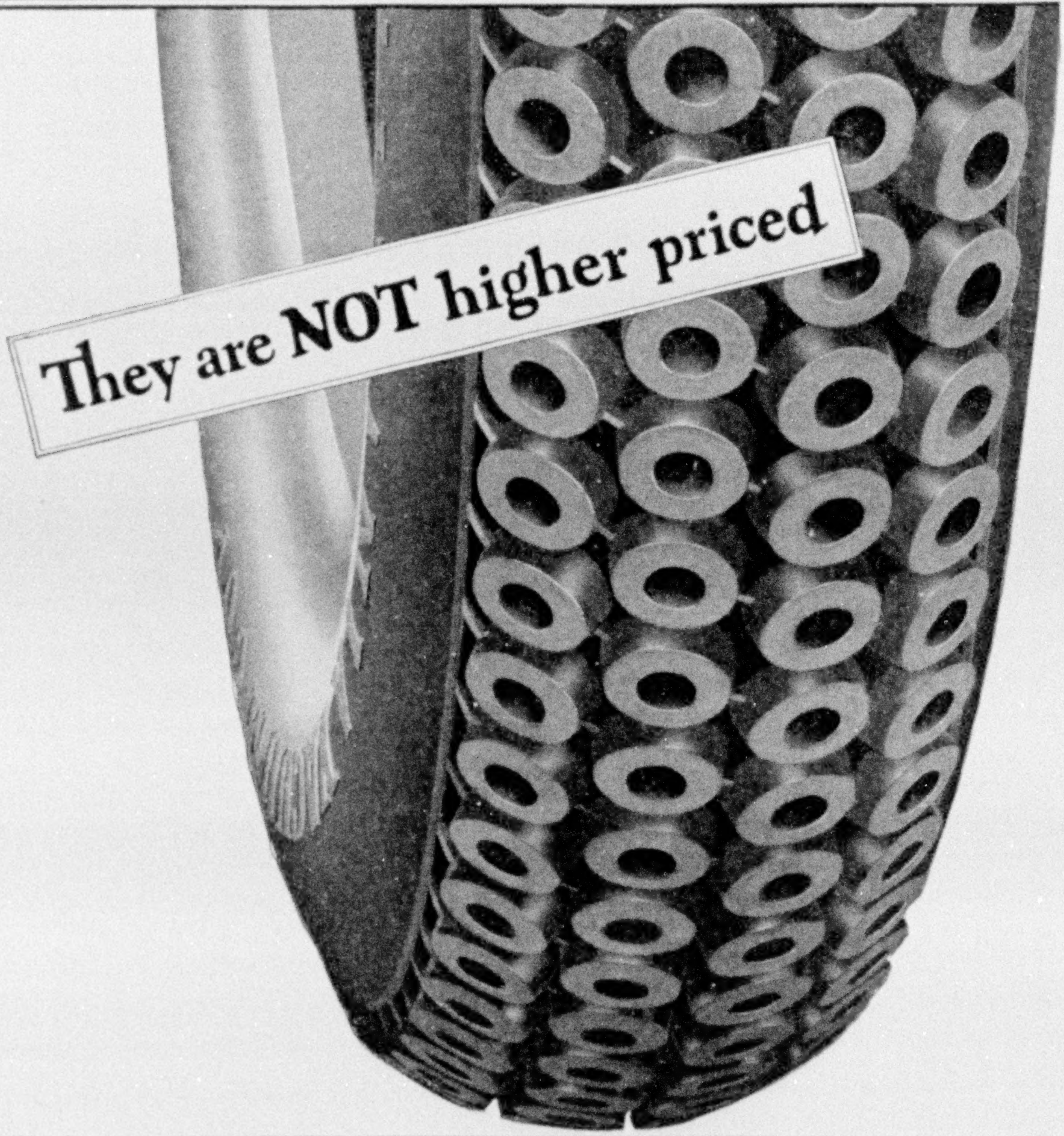
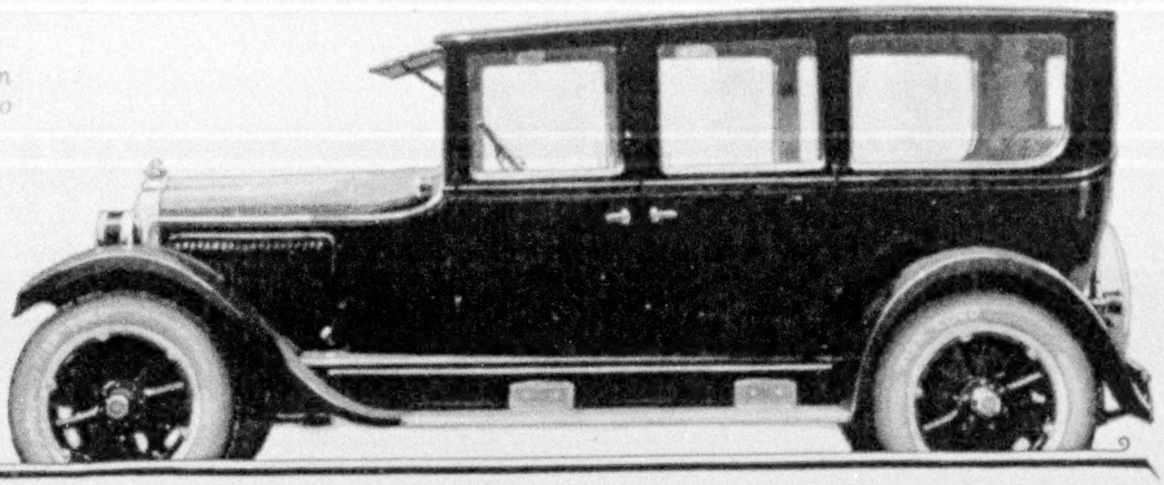

They are **NOT** higher priced

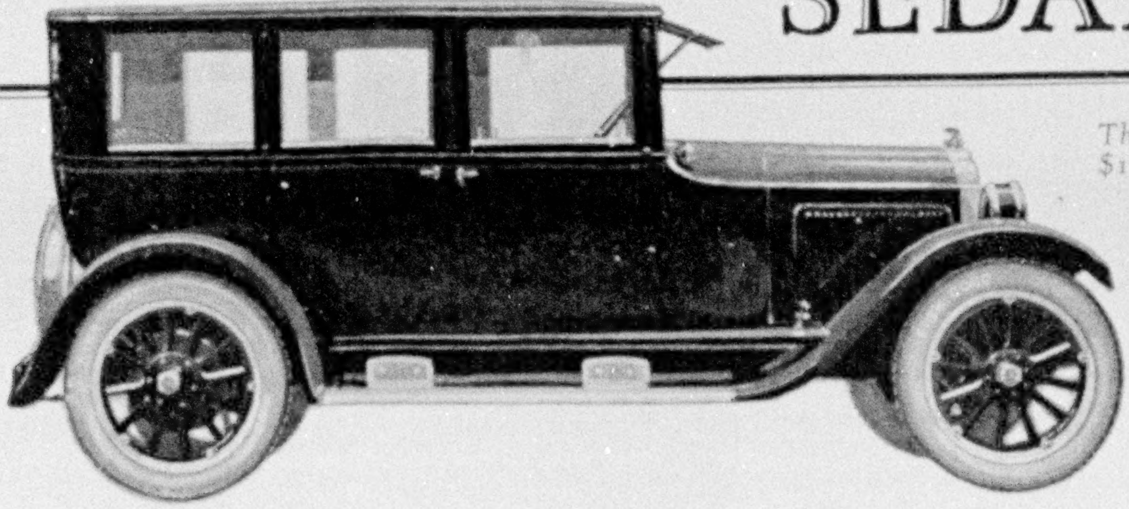
Twenty-four hours a day year-round production keeps prices down!

PENNSYLVANIA RUBBER COMPANY OF AMERICA, INC., Jeannette, Pa.

The 7-passenger Sedan
$1995 f. o. b. Toledo



Announcing the New
WILLYS-KNIGHT
SEDANS



The 5-passenger Sedan
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A new distinction—noticeably longer lines—added comfort and convenience—an astonishing degree of inside quiet—these are outstanding attributes of the new Willys-Knight 5- and 7-passenger Sedans.

Wilson built bodies, finished in Baker Fastex Velour, deep cushioned, with full-opening door windows easily operated by crank-type window regulators, are some of the new refinements in motor cars already famous for beauty, comfort, sturdiness and the Willys-Knight sleeve-valve engine which improves with use.

Other Willys-Knight models: 5-pass. Touring $1175, 2-pass. Roadster $1175, 7-pass. Touring $1435, 5-pass. Country Club $1635, 5-pass. Coupe-Sedan $1550; f. o. b. Toledo. We reserve the right to change prices and specifications without notice.

WILLYS-OVERLAND, INC., TOLEDO, OHIO
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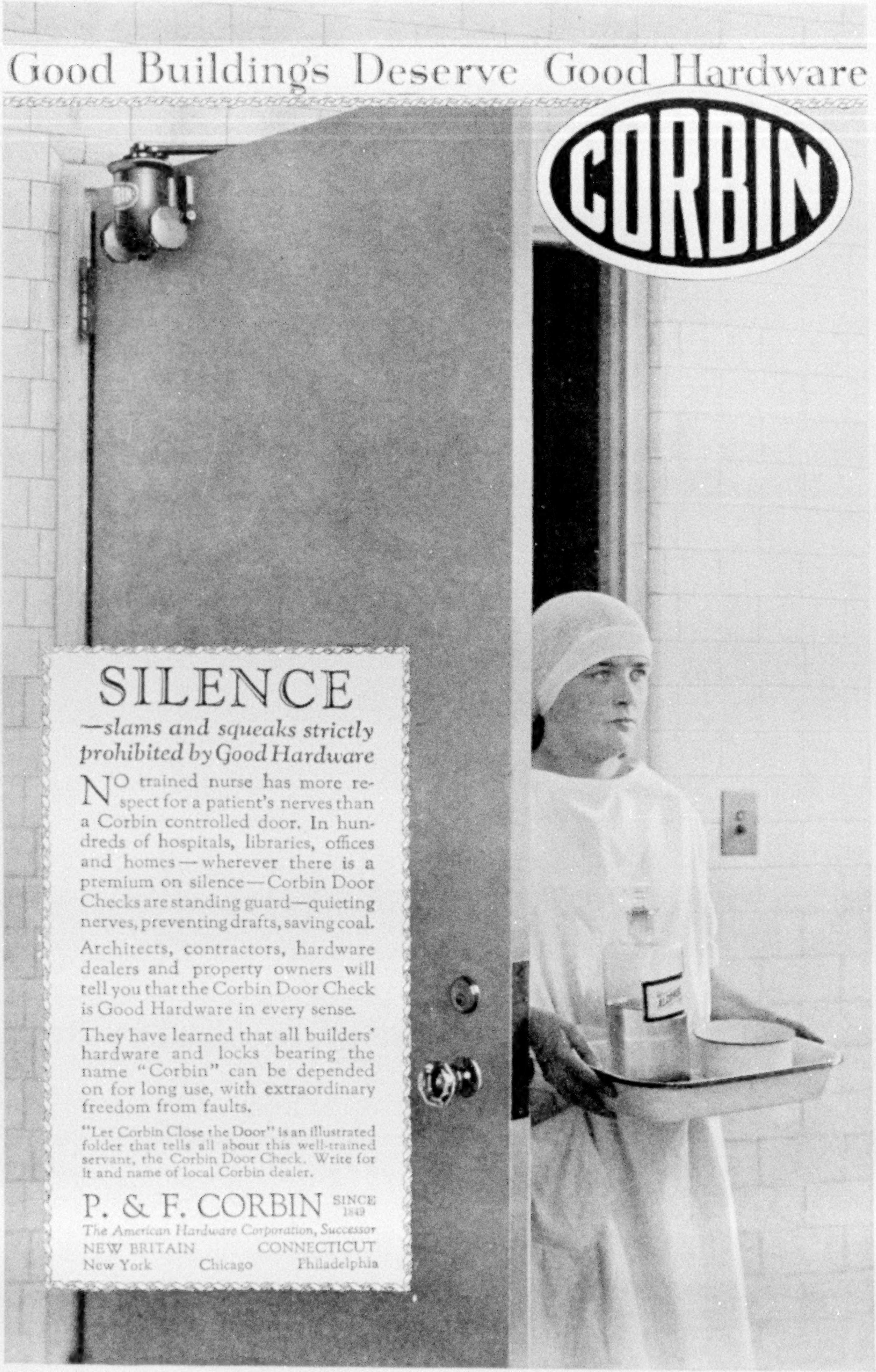


Good Buildings Deserve Good Hardware

CORBIN

SILENCE

—slams and squeaks strictly prohibited by Good Hardware

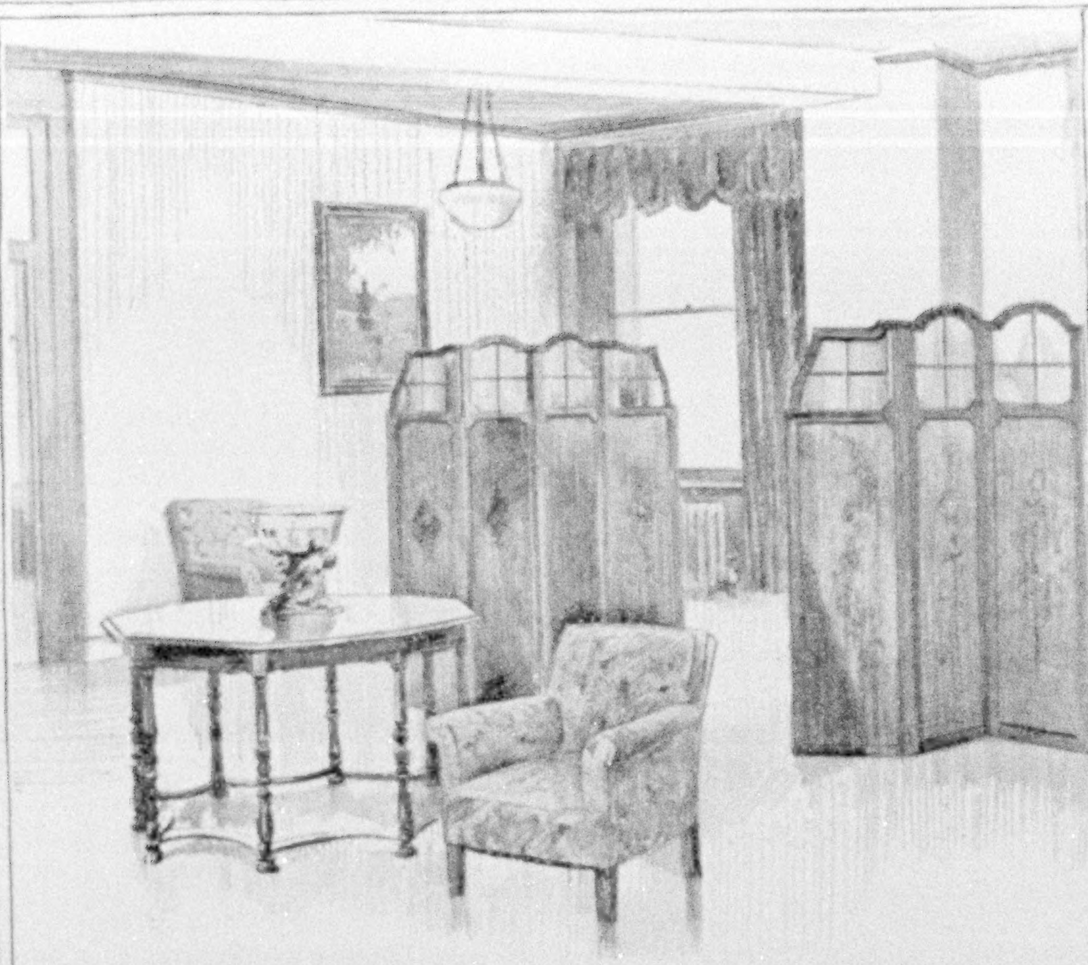
NO trained nurse has more respect for a patient's nerves than a Corbin controlled door. In hundreds of hospitals, libraries, offices and homes—wherever there is a premium on silence—Corbin Door Checks are standing guard—quieting nerves, preventing drafts, saving coal.

Architects, contractors, hardware dealers and property owners will tell you that the Corbin Door Check is Good Hardware in every sense.

They have learned that all builders' hardware and locks bearing the name "Corbin" can be depended on for long use, with extraordinary freedom from faults.

"Let Corbin Close the Door" is an illustrated folder that tells all about this well-trained servant, the Corbin Door Check. Write for it and name of local Corbin dealer.

P. & F. CORBIN SINCE 1849
The American Hardware Corporation, Successor
NEW BRITAIN CONNECTICUT
New York Chicago Philadelphia



The
FIFTH
Avenue
Building
200 Fifth Ave.
New York

By the company you keep

A MAN is known by the company he keeps. Likewise a business corporation.

The influence of this ancient and proper precept has drawn together in The Fifth Avenue Building a tenant-list representing the highest types of business firms. Grouped together in one of the best office buildings in New York, these firms, recognized leaders in their respective lines, mutually profit by the association.

Many of the occupants have deemed it worth while to furnish their offices in keeping with the nature of their business and their commercial standing. For this purpose, the spacious, high-ceilinged, well-lighted and airy rooms of the building are well suited and easily adapted.

Situated at the intersection of two world-famous streets and facing the broad open space of Madison Square, The Fifth Avenue Building is the ideal location for New York offices.

THE FIFTH AVENUE BUILDING
Broadway and Fifth Avenue, at Madison Square, New York

"More than an office building"

ROCK OF AGES TRADE MARK

For Granite Monuments Which Endure

ROCK OF AGES TRADE MARK

Time is the severest of critics. Of all the creations in the realm of art, literature, and music, only those of genuine worth have survived.

Thus it is with the products of the quarry, from which we are wont to fashion monuments to the memory of those we love.

Rock of Ages Granite, found in deep, rich veins in the hills of Vermont, is a granite which will stand the test of time. Its enduring hardness has been proven—its handsome, mottled grain and beautiful gray color are the admiration of those who love beautiful things.

Rock of Ages in polished finish is noted for its luster and brilliance—for hammered work it is equally distinctive.

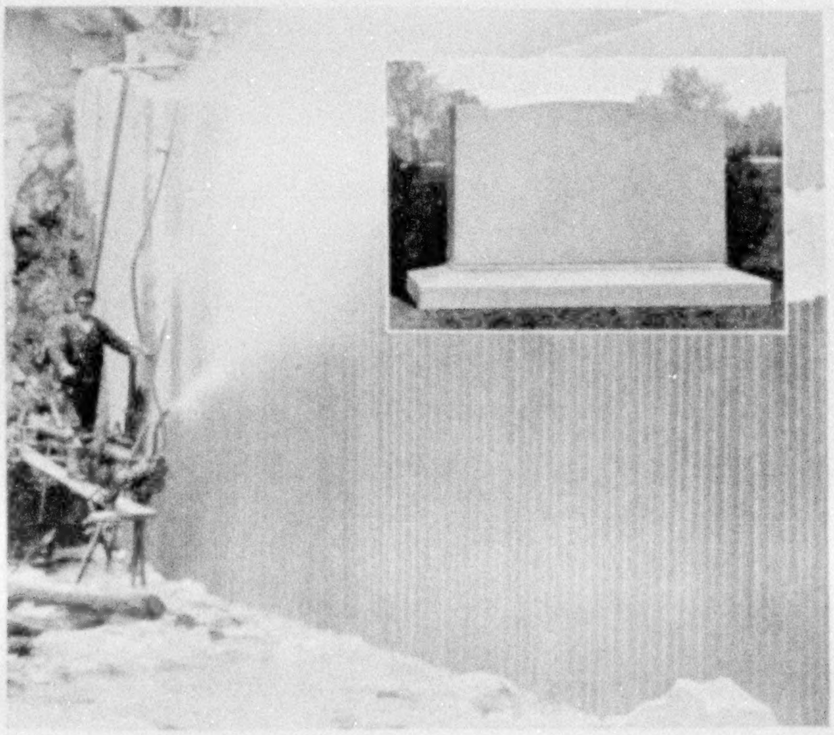
A family memorial of your own choice in Rock of Ages will be a lasting satisfaction to you.

A Certificate protecting you against inferior granites will accompany each memorial of ROCK OF AGES, if your request is made when placing order with your local monument merchant.

Illustrated Booklet "E" Upon Request

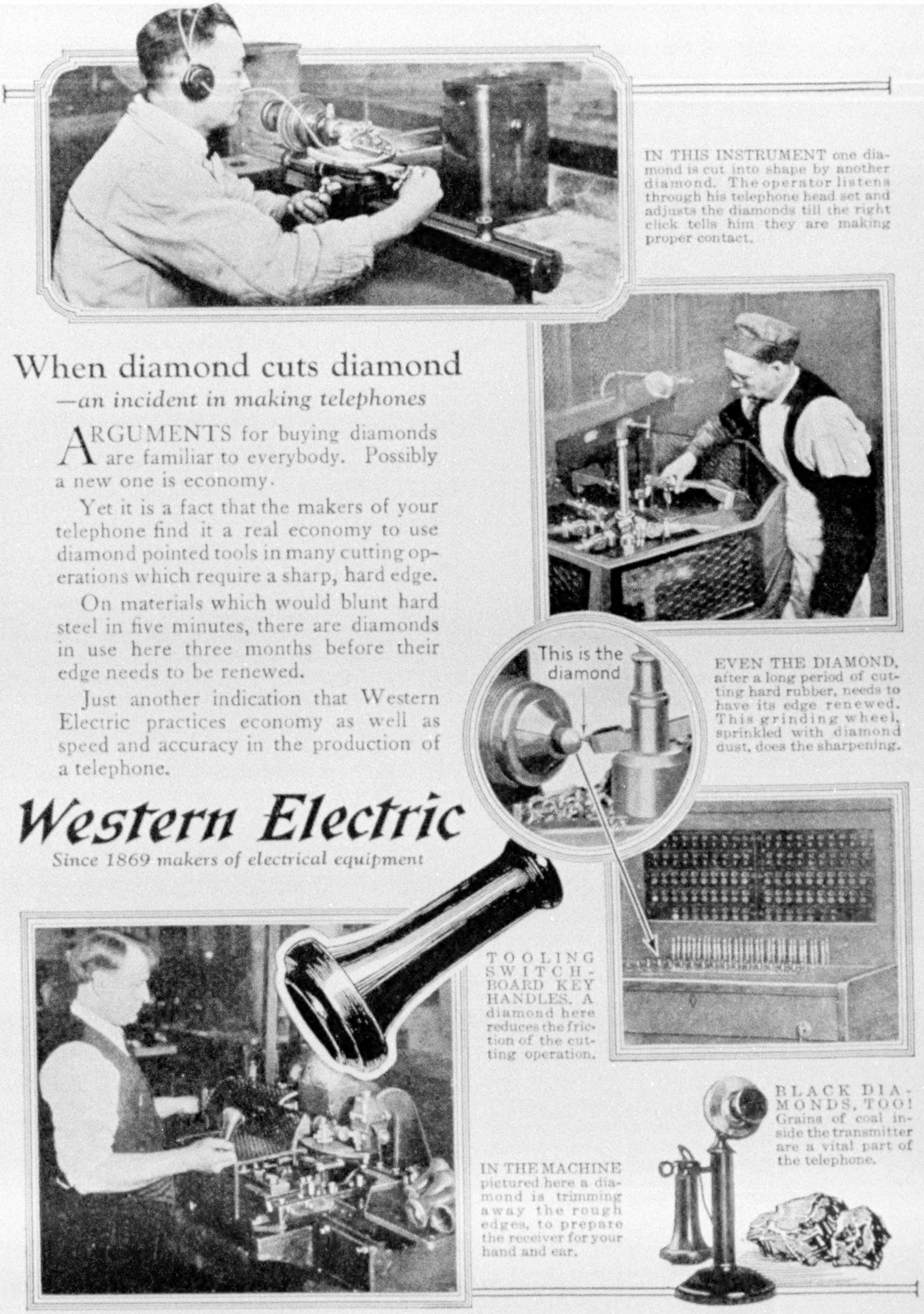
Boutwell, Milne & Varnum Company

Montpelier, Vermont



Quarriers of ROCK OF AGES Granite

America's Choicest Monument Material



When diamond cuts diamond

—an incident in making telephones

ARGUMENTS for buying diamonds are familiar to everybody. Possibly a new one is economy.

Yet it is a fact that the makers of your telephone find it a real economy to use diamond pointed tools in many cutting operations which require a sharp, hard edge.

On materials which would blunt hard steel in five minutes, there are diamonds in use here three months before their edge needs to be renewed.

Just another indication that Western Electric practices economy as well as speed and accuracy in the production of a telephone.

Western Electric

Since 1869 makers of electrical equipment

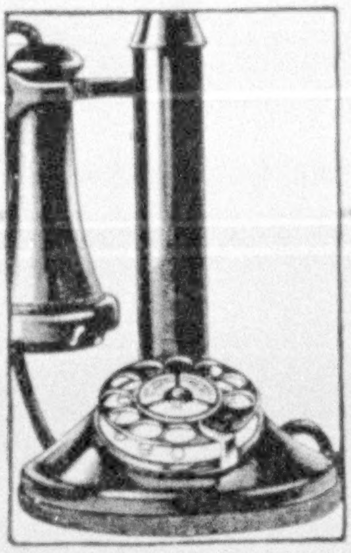
IN THIS INSTRUMENT one diamond is cut into shape by another diamond. The operator listens through his telephone head set and adjusts the diamonds till the right click tells him they are making proper contact.

EVEN THE DIAMOND, after a long period of cutting hard rubber, needs to have its edge renewed. This grinding wheel, sprinkled with diamond dust, does the sharpening.

TOOLING SWITCHBOARD KEY HANDLES. A diamond here reduces the friction of the cutting operation.

BLACK DIAMONDS, TOO! Grains of coal inside the transmitter are a vital part of the telephone.

IN THE MACHINE pictured here a diamond is trimming away the rough edges, to prepare the receiver for your hand and ear.



For All Your
Intercommunication Needs

What the P-A-X is doing for nearly 2000 dominant business organizations it will do for you.

1 Handle all your intercommunicating calls at no expense for operators' salaries.
2 Materially reduce your expense for rental of telephone instruments.
3 Save you eighteen seconds on every call.
4 Keep you in constant touch with every department of your business.
5 Give you twenty-four-hour service.
6 Insure absolute secrecy.
7 Give you the advantages of the "Conference Line," "Code Call" and other Automatic Services.

3 Seconds! That's the longest it takes to make a P-A-X connection—a saving of 18 seconds per call.

One P-A-X user reports that 1,191⅓ hours a year were saved to his organization by this particular time-saving feature alone. He did not attempt to estimate the hours of unnecessary work avoided, nor the vital minutes gained by the co-ordinating services of this most highly developed and complete interior telephone system known.

Have you figured what it is costing you to do without the P-A-X? Our book, "The Straight Line," will give you the facts. Will you use coupon or write for your copy?

P-A-X

TRADE MARK

THE PRIVATE AUTOMATIC EXCHANGE

The P-A-X is similar to the Automatic Telephone equipment being so widely adopted for city service. It augments and completes, but neither supplants nor connects with local or long distance telephone service.

Automatic Electric Company

ENGINEERS, DESIGNERS & MANUFACTURERS OF THE AUTOMATIC TELEPHONE IN USE THE WORLD OVER

HOME OFFICE AND FACTORY: CHICAGO, U. S. A.

Branch Offices in All Principal Cities

EXECUTIVES' COUPON—For Complimentary Copy of the Booklet "The Straight Line."

Automatic Electric Co., 947 W. Van Buren St., Chicago, Ill.

Gentlemen: Please send me "The Straight Line." N-4

Name..........

Title..........

Name of my Company..........

Address..........

THE wonderful photographic illustrations in The National Geographic are made possible only by use of such lenses as

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Ask your dealer for booklet, "What Lens Shall I Buy?" or write to us.

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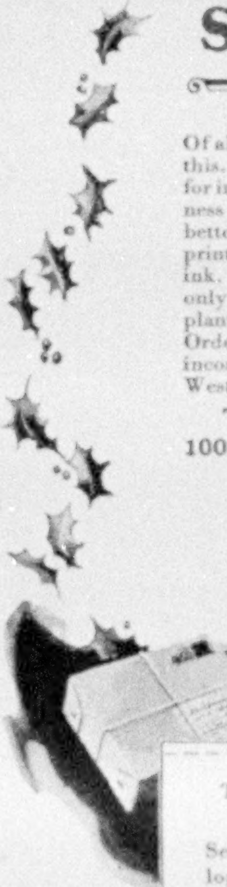
1003 Park Avenue Peru, Indiana



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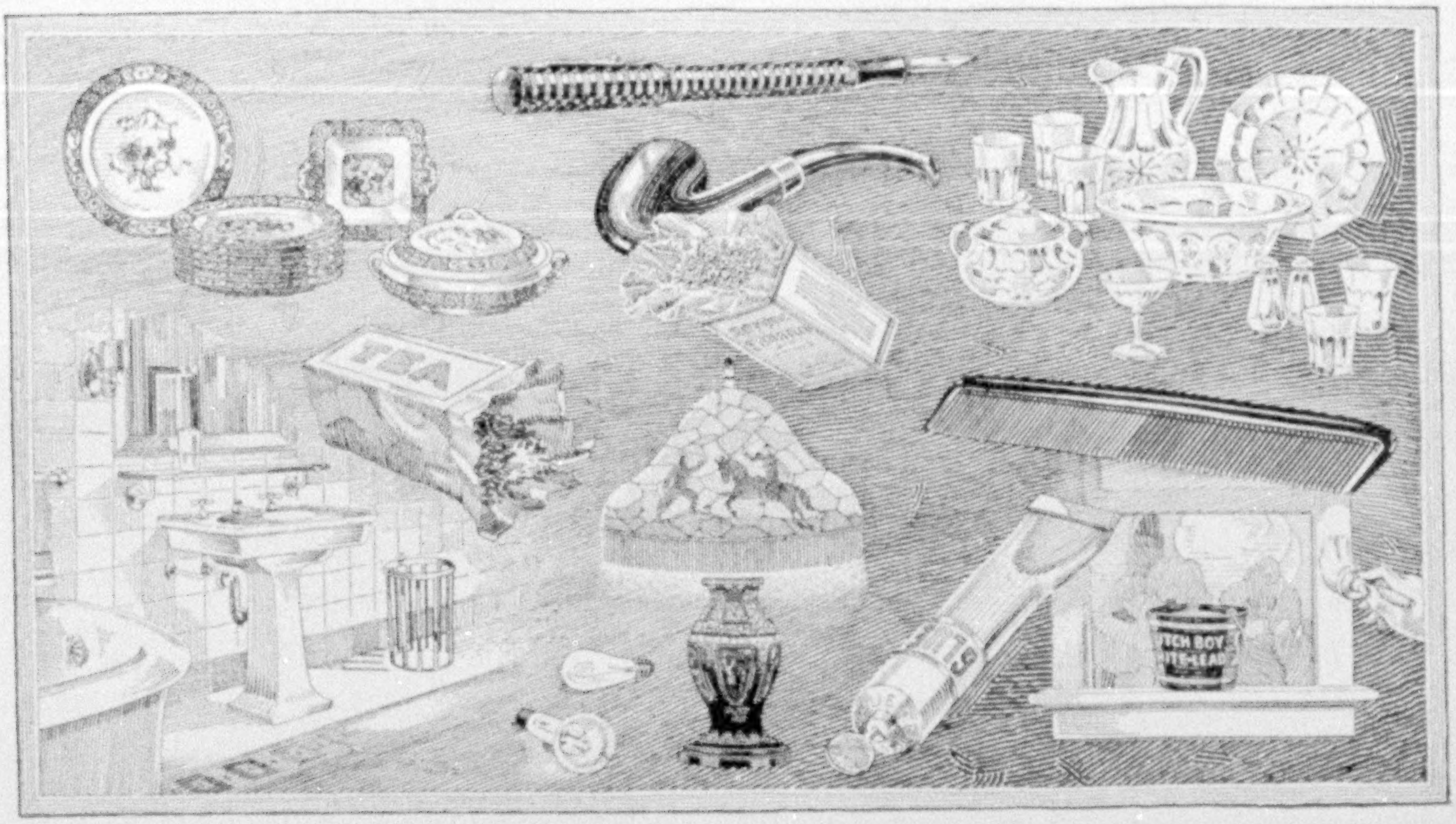


How lead serves in your home

LEAD has never been prized for its beauty, as have gold and silver and other precious metals. With a reputation as one of the baser metals, lead has had few admirers.

Yet lead today, because of the many services it renders, is to be found in homes everywhere.

In the bathroom

Lead is an important ingredient in making the glossy white enamel that covers the iron tub and basin and the glazed tile walls in your bathroom.

The lead oxides, either litharge or red-lead, are mixed with several other materials and melted. This makes a molten glass which changes into fine white granules when plunged into cold water. A mixture of these granules and water is spread on the iron body of tub and basin and the casting is fired at high temperature. When cooled it presents the beautiful hard enamel surface with which we are familiar.

On the dining-room table

In practically the same way as lead enamel is put on the bath-tub, the potter uses white-lead, litharge, or red-lead to help produce the smooth, hard glaze on the fine china plates, cups, and saucers you have on your dining-room table. Cut-glass bowls and dishes on your table are from one-third to one-half lead.

Lead is in every room

Electric light bulbs throughout your house are made of fine lead glass. Red-lead helps to seal radiator joints. Rubber stoppers in bath-tub and basins have lead in them. The hard rubber of your comb contains lead.

On your desk may be collapsible paste and glue tubes made of lead alloy. If your table lamp has a shade of ornamental glass, the bits of glass are held together by lead-tin solder.

"Save the surface and you save all" – Paint & Varnish

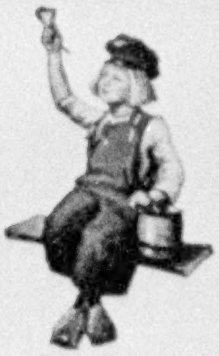
Lead is in the hard rubber stem of your pipe. Your tobacco and your tea are often contained in heavy lead-tin foil to keep them. There is lead in the hard rubber case of your fountain pen.

Lead on the walls

All these uses of lead are interesting and important. But its most important use is as paint.

Manufacturers use white-lead as the principal ingredient in the paint they make. Professional painters use a mixture of pure white-lead and linseed oil or flatting oil to save the surfaces they cover. Property owners everywhere are being rapidly converted to the necessity of protecting their houses with paint. The phrase, "Save the surface and you save all," is recognized as a truth. Use durable lead, in the form of white-lead, as *your* surface saver.

Look for the Dutch Boy



NATIONAL LEAD COMPANY makes white-lead of the highest quality and sells it, mixed with pure linseed oil, under the name and trademark of *Dutch Boy white-lead.* The figure of the Dutch Boy is reproduced on every keg of white-lead and is a guarantee of exceptional purity.

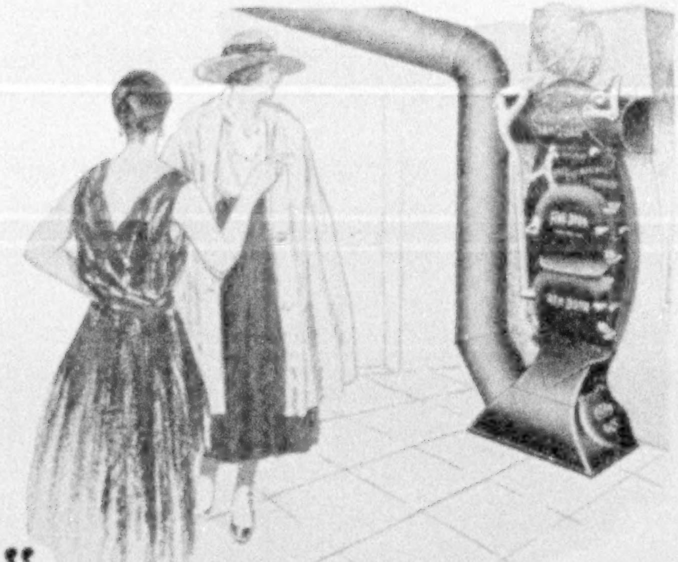
Dutch Boy products also include red-lead, linseed oil, flatting oil, babbitt metals, and solder.

More about lead

If you use lead, or think you might use it in any form, write to us for specific information.

NATIONAL LEAD COMPANY

New York, 111 Broadway; Boston, 131 State St.; Buffalo, 116 Oak St.; Chicago, 900 West 18th St.; Cincinnati, 659 Freeman Ave.; Cleveland, 820 West Superior Ave.; Pittsburgh, National Lead & Oil Co. of Pa., 316 Fourth Ave.; Philadelphia, John T. Lewis & Bros. Co., 437 Chestnut St.; St. Louis, 722 Chestnut St.; San Francisco, 485 California St.



"—and here's our heating plant"

¶"Indeed, it's more than that. It not only gives us plenty of heat, evenly distributed to every part of the house, but keeps every room thoroughly ventilated—filled with an atmosphere delightfully fresh and invigorating.

¶"No dust, dirt, gases, or fire poisons can get into the rooms from this furnace because of the heavy copper-bearing steel fire-box, electrically welded into one piece without seams or rivets.

¶"But, Helen, what an unusual shape it has!"

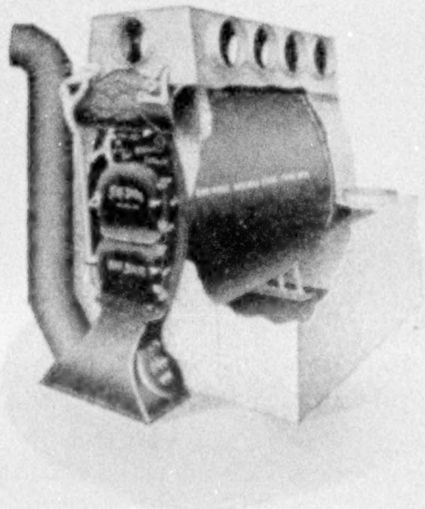
¶"Yes, that's one of its exclusive features. The elliptical fire-box gives greater heating surface than ordinary furnaces, with no projections to form air-pockets. Its longitudinal position provides larger grate area which insures slow combustion. That's why it uses so little fuel.

"And here's a feature we wouldn't part with—the automatic control. Clark says it's worth the cost of the plant. We never worry about our fire day or night. This control lever—operated by the fire-box—prevents the house getting too hot or too cold. We simply fill the fire-box each evening, then it takes care of itself for twenty-four hours without danger from overheat or wasting fuel. Why shouldn't we be enthusiastic?

¶"Honestly, Clara, we wouldn't part with our FarQuar for anything—and neither would you if you had one. Why don't you send for their booklet? It contains a wonderful story about heating and they'll send it free to any home owner or builder." Address—

The Farquhar Furnace Co.
910 FarQuar Bldg. Wilmington, Ohio

THE SANITARY
FARQUAR
HEATING AND VENTILATING
SYSTEM
It heats with Fresh Air



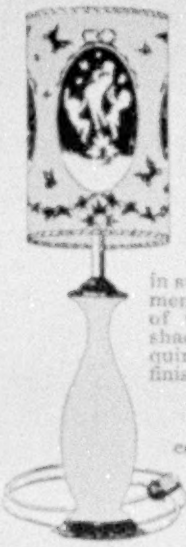
THE VOSE GRAND

has incomparable *Tone*—the one quality above all others which makes a real piano. The exquisite tone of the Vose Grand distinguishes it from all other pianos.

We Challenge Comparisons. Write for beautifully illustrated catalog and floor pattern of the Vose Grand; also our easy payment plan.

Vose & Sons Piano Co., 146 Boylston St., Boston

VOSE



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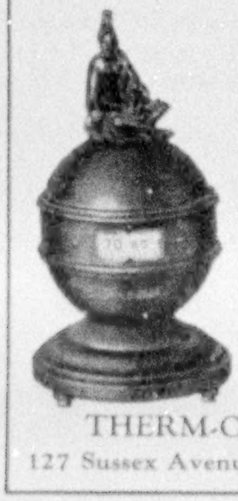

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THE ART THERMOMETER

An ornamental, distinctive, practical thermometer that will appeal to refined folks seeking something in a unique Christmas gift.

INDIAN MODEL
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GOLF MODEL ALSO $7.50
OTHERS $4 to $10

Booklet on request

THERM-O-DIAL LABORATORIES
127 Sussex Avenue Newark, N. J.

Styles for every room in the house

SANITAS
MODERN
WALL COVERING

Enriches the appearance of any home

SANITAS
Wipe off the Dirt

Sanitas is appropriate to any room, with its soft flat tints that can be made individual by stencilings, frescoes, or Tiffany blending, or with selections from the large variety of cheerful, colorful patterns.

But Sanitas offers more than beauty. It is made on cloth, ready-painted with durable oil colors. Does not crack, tear, peel, or fade, and can be wiped clean with a damp cloth. Can be hung as soon as plaster is dry. Cracks in old walls, properly filled, do not show through.

Styles for every room in the house.

Enamel Finish plain colors, tile and mosaic effects, for kitchens, bathrooms, etc.

Flat Finish plain tints, that can be hung as they come, or stenciled, frescoed, stippled, or Tiffany blended.

Decorative Patterns, floral designs, reproductions of tapestry, leather, grass-cloth, and fabrics.

See Sanitas at your decorator's.
Write us for samples and booklet.

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Hiking

A wonderful exercise; healthful and invigorating, too.

It works your weight down; it works your appetite up.

Yes, there's the appetite to be considered; and the food must be carried; so it should be strength-giving without bulk—worth without weight.

What could better answer these requirements than Kraft Cheese in tins? Here is the concentrated goodness of pure sweet milk in compact, convenient form. There's a full meal in one of these little tins that you can carry in your pocket.

Remember this and have a supply on the pantry shelf for your next outing. Then you can spread your sandwiches fresh where you eat them. There are eight kinds of Kraft Cheese in tins, and each seems better than the other.

No rind—it spreads. No waste
—100% cheese
Cheese Recipe Book FREE

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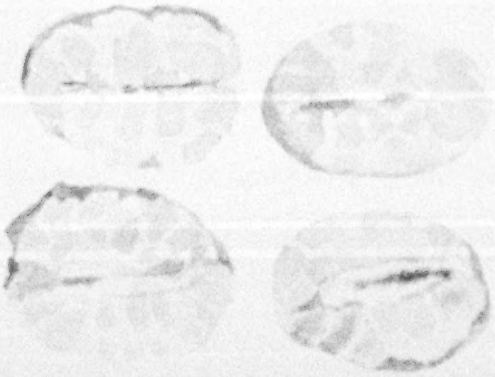

Flakes much enlarged

Note the Bran

Hidden in luscious flakes

Bran aids good health and good cheer as you know. It should be eaten daily. Then let us help you make it inviting.

PETTIJOHN'S
BREAKFAST FOOD

Pettijohn's hides the bran in delicious flakes of rolled soft wheat—the most flavory wheat that grows. So it supplies whole wheat nutrition, with its minerals and vitamines, plus 25% of bran. Both combined in a favorite morning dainty.

This dish will delight you, as will its results. Try it tomorrow.

Pettijohn's

Rolled Wheat—25% Bran

Salt & Pepper

Is there some particular friend to whom you want to send a suitable birthday, anniversary, or holiday remembrance? Here it is. Individual salt and pepper of extra heavy Sheffield silver. Design includes figures of little Dutch boy and girl. Fine workmanship and finish. They complete attractive table appointments. $1.50 a pair postpaid. Ask for No. 4679. Our Year Book of gifts shows more than 600 other unique, interesting, and useful gift suggestions. It is free. Write for it.

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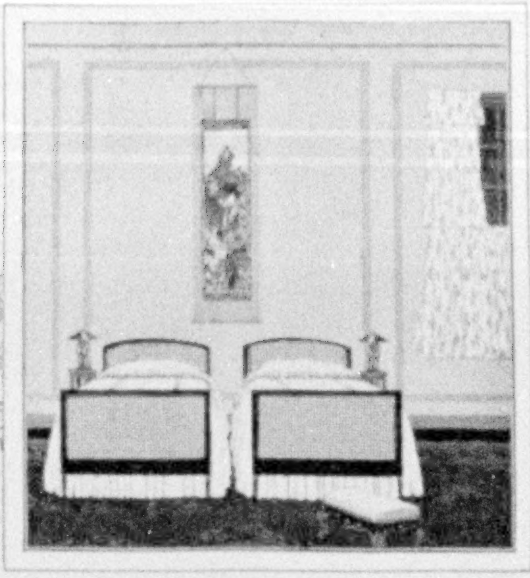


Simmons "Lakewood" beds. In lacquer red with panels of Simmons cane.

Finished also in walnut, mahogany, old blue, ivory and soft jade green.

The oldest and best "rest-cure" is sound sleep every night

Do you meet your mornings with a smile and an eagerness to be up and doing? You can. Deeper sleep is the way. And you owe it to yourself to find that way as soon as possible.

Better health, greater energy, clearer vision are the rewards of sound, untroubled sleep. Such rest can be had only on a spring and mattress that allow you to relax completely and at once, and leave you undisturbed the whole night long.

Before you go to bed tonight, take time to see what you are sleeping on. Call on your furniture dealer tomorrow and compare your outfit with the quality and cradling comfort of the Simmons springs and mattresses he will show you.

The range of styles and prices is wide enough to suit every taste and income, large or small.

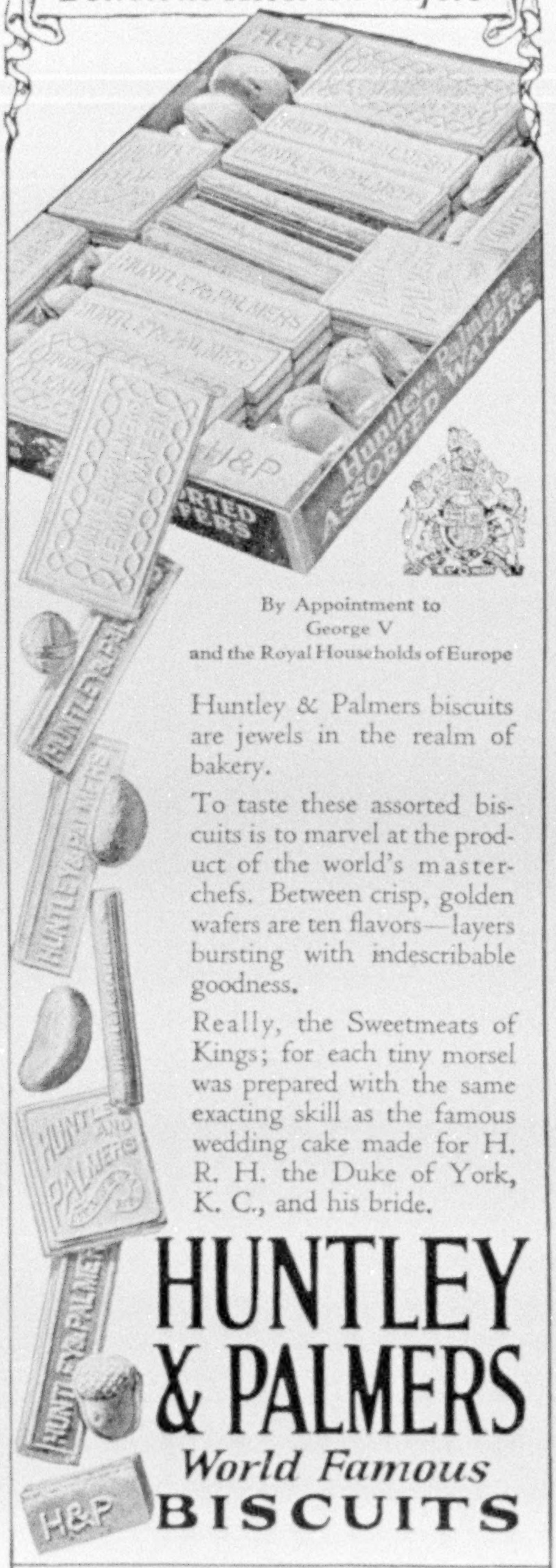
Note the difference between what you have and what you can so easily secure. Then decide whether energy and personal success are not worth more to you than the trifling cost of Simmons sleep equipment.

Write for your copy of "Restful Bedrooms" to The Simmons Co., 1347 S. Michigan Ave., Chicago
In Canada, please address Simmons Limited, 400 St. Ambroise Street, Montreal, Quebec

SIMMONS

Beds · Mattresses · Springs

BUILT FOR SLEEP



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Delicious Assorted Wafers

By Appointment to
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Huntley & Palmers biscuits are jewels in the realm of bakery.

To taste these assorted biscuits is to marvel at the product of the world's master-chefs. Between crisp, golden wafers are ten flavors—layers bursting with indescribable goodness.

Really, the Sweetmeats of Kings; for each tiny morsel was prepared with the same exacting skill as the famous wedding cake made for H. R. H. the Duke of York, K. C., and his bride.

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A Garden Full of Darwin Tulips for $2.00

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CLARA BUTT

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50 Giant Darwin Tulip Bulbs, Finest Mixed, for $2.00
selected from fifteen named varieties

Few spring flowering plants rival the Darwin Tulip for brilliance of bloom. Borne on strong stems often exceeding three feet. They are a wonderful addition to the flower garden.

Plant any time before the ground becomes frozen, and they will bloom from the middle of May to Decoration Day

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Our 1923 Fall Bulb Catalogue sent on request

Stumpp & Walter Co
30 and 32 Barclay Street New York

The Windmill Tea Ball

Here is a charming new design that will appeal to the lover of the novel and artistic. Made of Sheffield silver in Dutch design. When not in use the tea ball hangs from the windmill. A thoughtful gift for a good friend. Ball and tray complete, $3.50, postpaid. Ask for No. 4677. Our new Year Book will help you greatly in making holiday gift selections. It shows hundreds of interesting, useful, and out-of-the ordinary things. It is free—send for it.

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GENERAL PRESENTATION PURPOSES
The 8-day, High-Grade, World-Renowned
"CHELSEA"
MANTEL, BOUDOIR, SHIP'S BELL, AUTO. AND YACHT CLOCKS

In bronze metal and mahogany (period) cases. Cost more than others, but the value is there. All others are comparative. ASK any USER.

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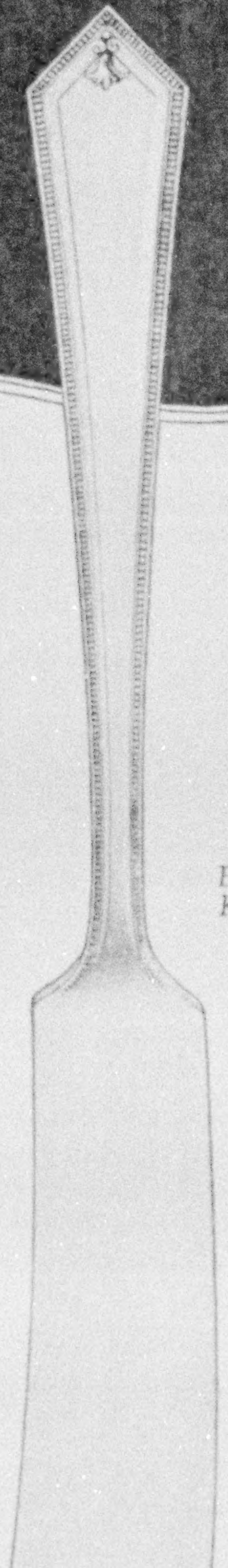

Yesterday's Gift to Tomorrow

NO period of our history had more charm than the days of Old Virginia, when living was an art and hospitality something more than a passing gesture.

The spirit of those years, with their leisurely graces, has been caught in the Richmond pattern of Alvin Solid Silver. It has the timelessness of true art, and its appeal will hold throughout the generations that silver endures.

If you would like, we will mail you a leaflet illustrating some of the most popular Richmond pieces. At the same time we will send you, without charge, our authoritative booklet, "Setting the Table Correctly," by Oscar of the Waldorf-Astoria. There is no obligation; just write us a note.

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Also Makers of Alvin Long-Life Plate

The Richmond Pattern *of*

ALVIN

SOLID SILVER

(STERLING)

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Springtime here

A few short, enjoyable hours by Pullman and you are in the land of winter springtime—Tucson, Arizona.

Lawns are green. Zinnias, roses and chrysanthemums are blooming. Children romp outdoors. This is the season of rest and play in the Sunshine-Climate.

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Snap of mountain air and zest of desert climate combine to make each day from October to May a delightful natural tonic. Each year hundreds find physical regeneration in this perfect climate. For "nerves," "overwork," pulmonary troubles, and some types of asthma there is daily proof of the value of outdoor life here.

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Winter excursion rates now effective via Southern Pacific, El Paso and Southwestern, Rock Island and connecting lines. Excellent hotels. Rents reasonable. Golf and country clubs open to visitors. Hunting, Old Mexico, primitive Indians, miles of good highway, delightful social life. Moderate income sufficient.

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"Man-Building in the Sunshine-Climate" tells the story of Tucson. Just send the coupon.

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Sunshine-Climate Club
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Tucson Sunshine-Climate Club,
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Please send me your free booklet, "Man-Building in the Sunshine-Climate."

Name ____________________

Address ____________________

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"Glass Heads—Steel Points"

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10c pkts. Sold everywhere. In Canada, 15c.

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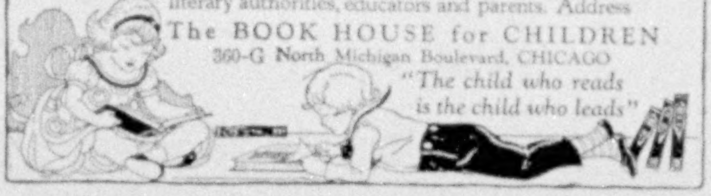

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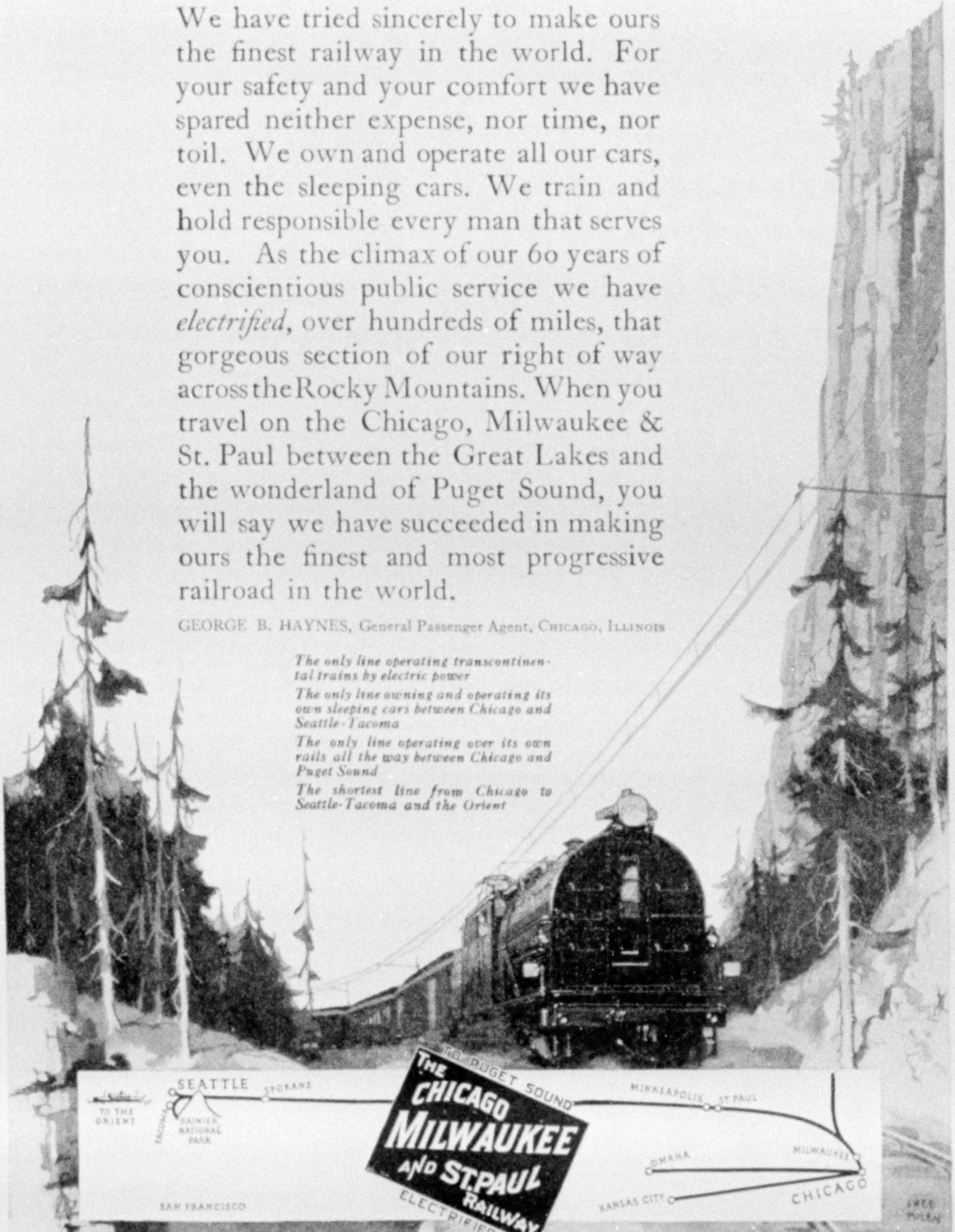

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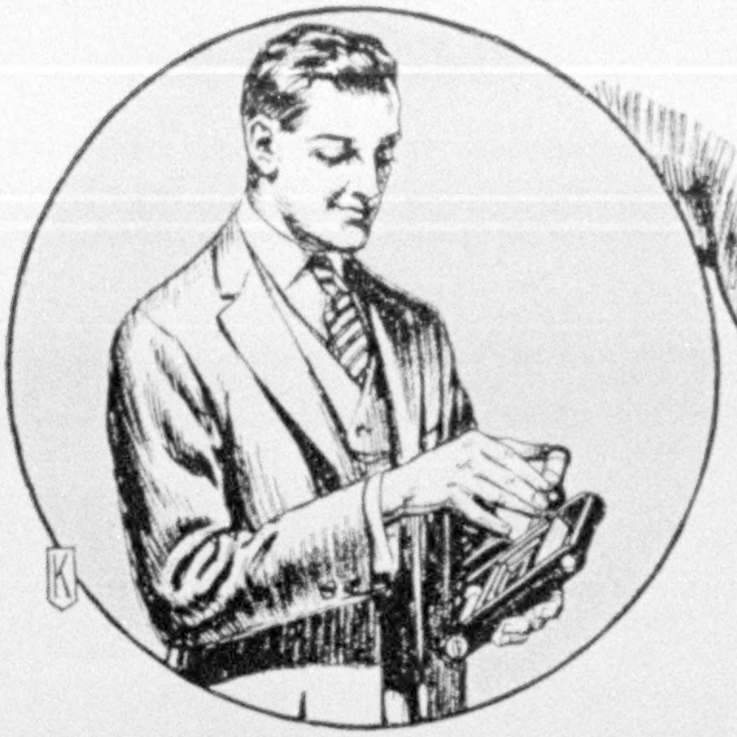

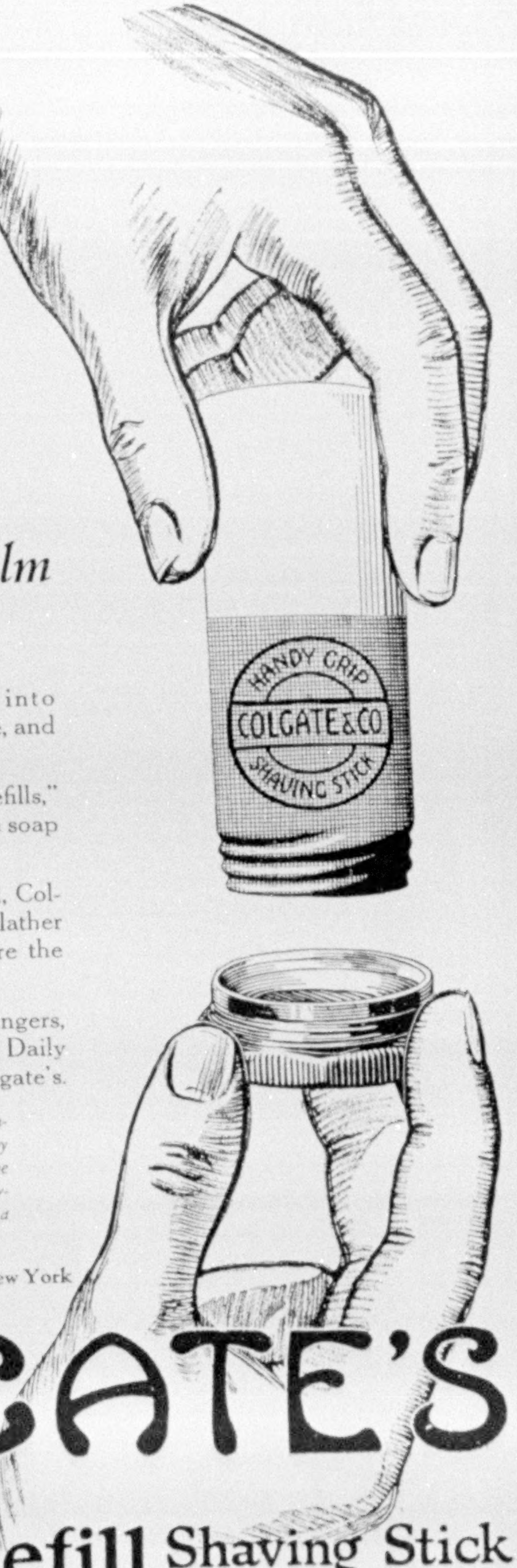

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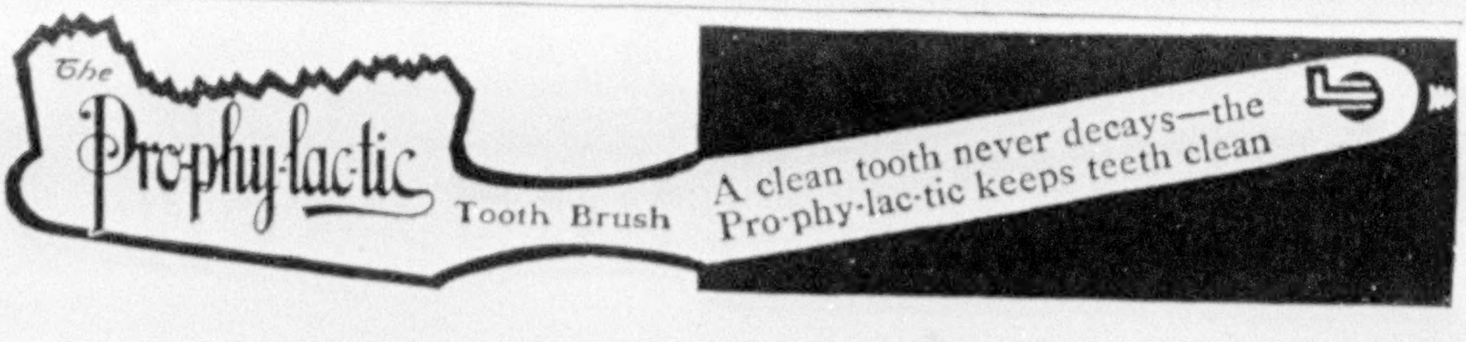
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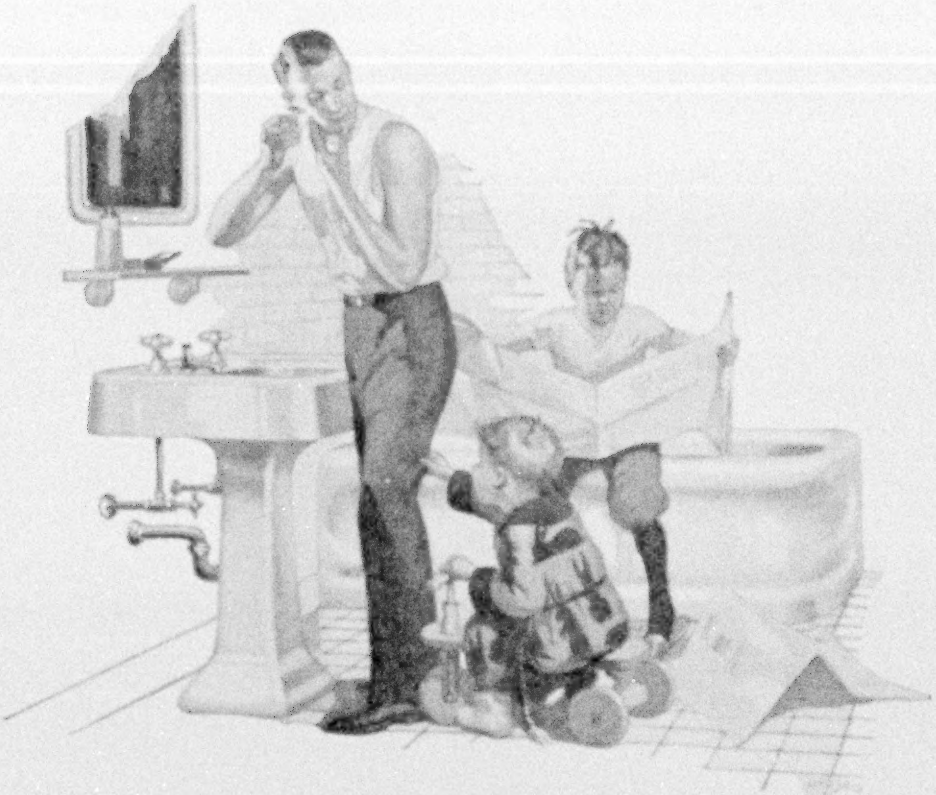

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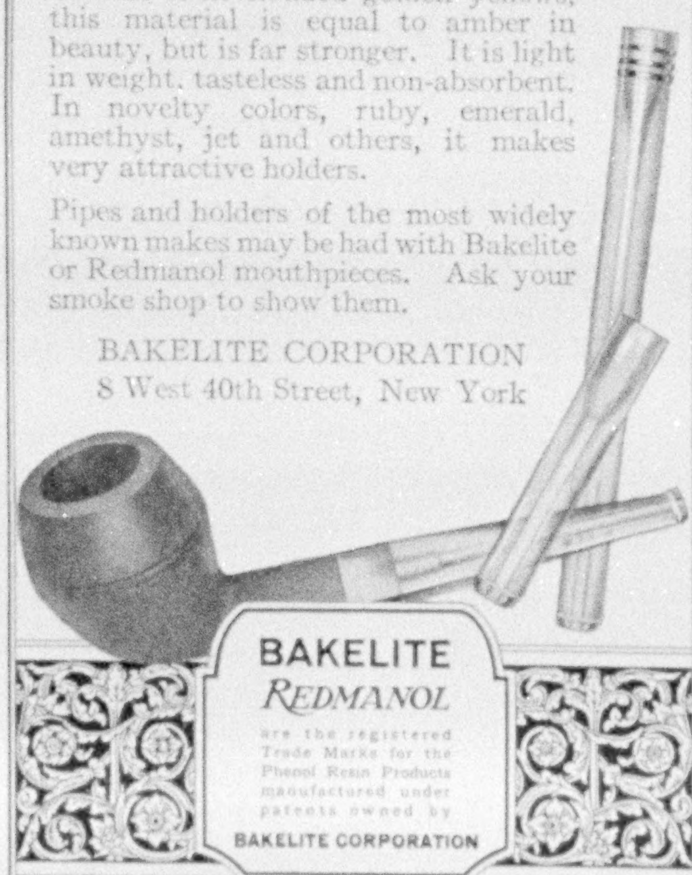

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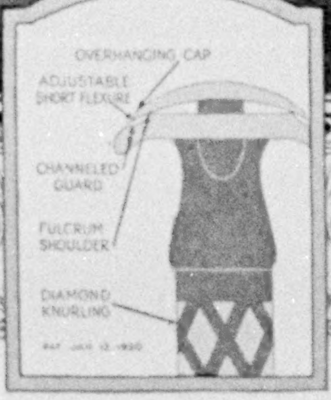
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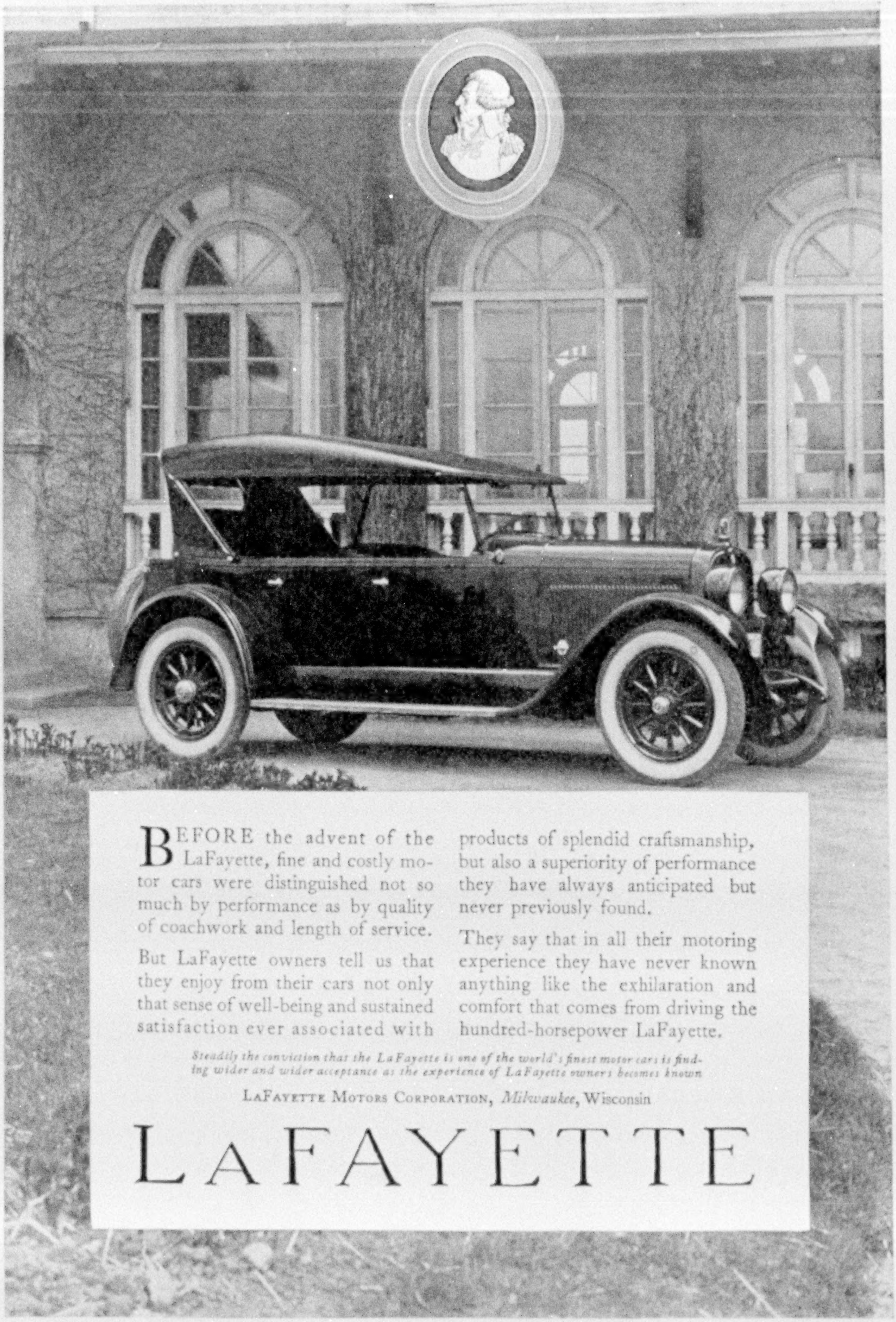

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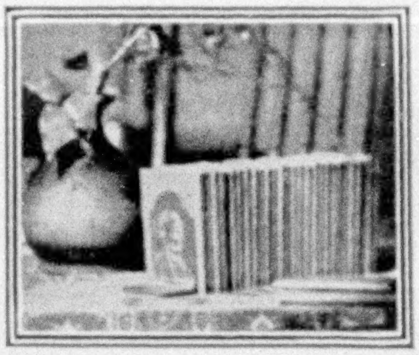

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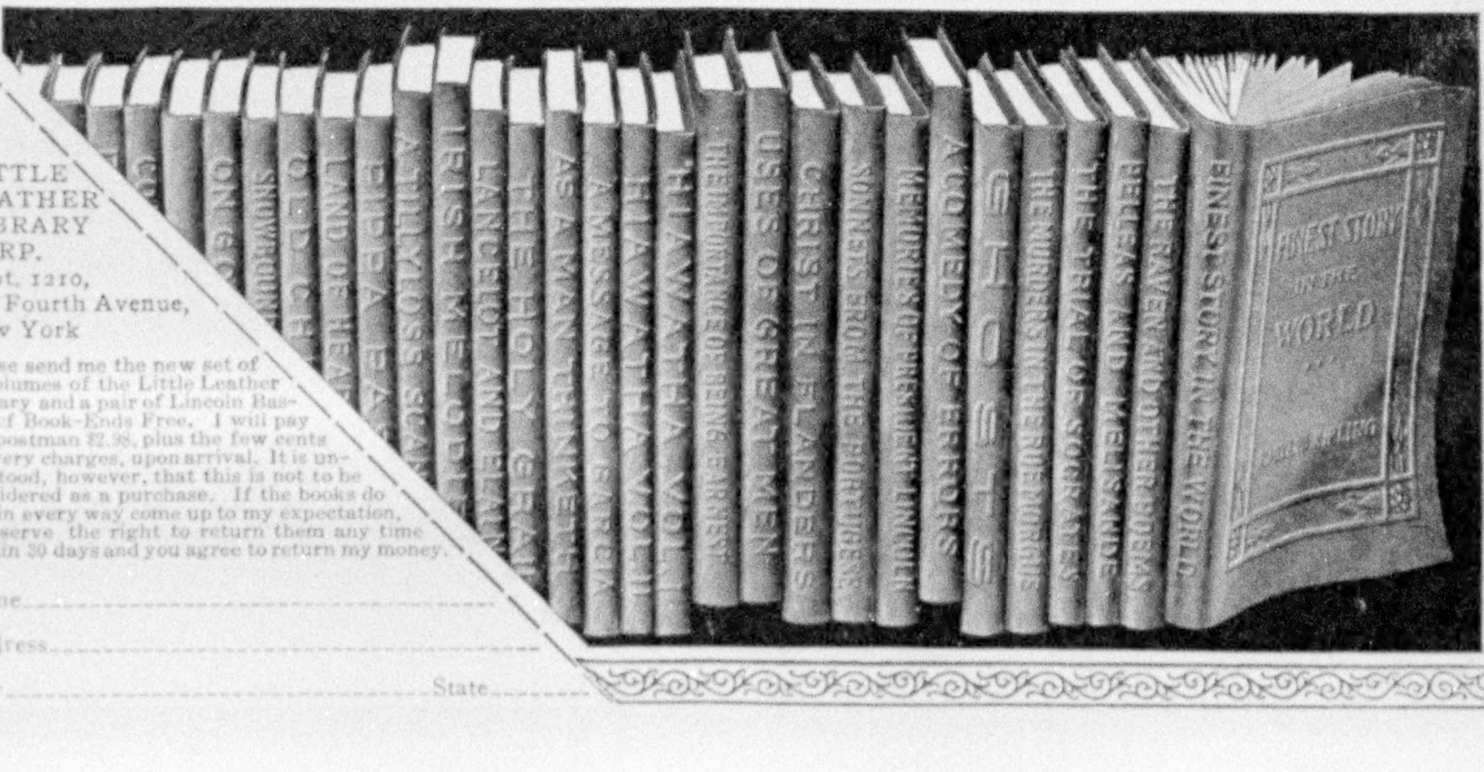

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